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A CLINICAL GUIDE
TO
BEDSIDE EXAMINATION

A CLINICAL GUIDE TO BEDSIDE EXAMINATION

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DIAGNOSTIC VALUE OF SOME OF THE PHYSICAL FINDINGS

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FOREWORD

THIS little volume was prepared with a view of furnishing the physician and student with a guide for the physical examination of a patient at the bedside. It is also intended to offer a nomenclature which may be used by the various schools and which may thus facilitate the recording and interpretation of history charts and reports of the results of the physical examination.

It is very important that the examination of the patient be thorough and that nothing escape observation by the physician. It is equally important that the findings be reported in a uniform and orderly manner and that negative as well as positive findings be recorded.

No detailed descriptions, theories or procedures requiring laboratory, graphic or other instrumental aid are discussed in this booklet. The reader is referred to books on these various subjects for a comprehensive study of the more complicated methods, as only the findings on inspection, palpation, percussion and auscultation are included in this volume.

This little booklet is offered to the profession with the hope that it will meet the requirements mentioned in the foregoing paragraphs.

THE AUTHORS.

INTRODUCTION

IT seems advisable, during a physical examination, to adhere to a certain schema so that the records will be uniform and complete, for which reason the following schema is suggested. Only the headings are mentioned as the more detailed discussion of the various points will be taken up in the subsequent chapters and in accordance with the order of their occurrence and regional distribution.

SCHEMA OF A PHYSICAL EXAMINATION AT THE BEDSIDE

General Condition

Age and sex.

Dimensions and proportions of the body.

Sensorium and position in bed.

Bony framework, musculature, panniculus adiposus.

Visible mucous membranes | icterus, cyanosis, other
 Skin | abnormal colors.

Edema.

Edema.

Edema.

Pulse at radial artery

Course and position of vessel.

Size and filling.

Wall.

Height of pulse wave, "celerity."

Blood pressure.

Frequency.

Equality and

Dicrotism.

Paradoxism.

Comparison of the pulse on the right and left sides.

Respiration.

Temperature.

The Several Parts of the Body

Head

Form, hairy parts.

Movements of the eye-ball, nystagmus.

Pupils: width, shape, difference in size, reaction to light, pain, accommodation, consensual sense.

Examination of the other cerebral nerves.

Ears and nose.

Tongue, throat, tonsils.

Neck

Shape.

Arteries, veins and their course and pulsations.

Thyreoid gland.

Lymph glands.

Larynx, voice.

Phrenic and vagus nerves.

Thorax

Shape and symmetry.

Epigastric angle.

Supra- and infra-clavicular fossæ.

Spine.

Lungs

Topographic and comparative percussion.

Determination of respiratory excursion of borders.

Auscultation of breath sounds, spoken and whispered voice.

Combined method of auscultation and percussion.

Vocal fremitus.

Heart

Inspection and palpation.

Apex beat, position, resistance, width and thrills.

Percussion.

Boundaries of cardiac dullness and dullness in median line (large vessels).

Auscultation. At apex (mitral valve), pulmonary artery, aorta, tricuspid valve, peripheral vessels.

Abdomen

Inspection and palpation.

Shape—Abdominal walls; contour of organs; abnormal resistance.

Percussion and auscultation.

Examination of the several organs as the liver, spleen, kidneys (pancreas).

Hernial rings, rectum and genitalia.

* * *

Motility—head, trunk and extremities.

Sensibility—skin and deep sensibility, temperature and pain.

Reflexes—skin, tendons, periosteum.

DETAILED CONSIDERATION OF THE FOREGOING SCHEMA AND THE DIAG- NOSTIC VALUE OF THE SEVERAL FINDINGS.

Inspection and Palpation.

I. GENERAL.

Position of the patient in bed (sitting, lying, active, passive, forced positions, etc.).

General Habitus—Size of the body, consideration of the various proportions of the body (comparison of upper to lower half, etc.), asymmetries.

Boney Framework (relatively large or small boned), configuration of the bones, condition of the epiphyses, swellings. Condition of the diaphyses. Exostosis. Bending deformities. Localized changes in consistency (infiltrations, hematoma, tumor, calcification, boney tumors).

Panniculus adiposus (poorly or well developed), distribution (generalized or localized to certain regions, tenderness). Note localization and distribution if unequally developed as, for example, to the abdomen, extremities, etc.

Skin—General condition. Whether delicate or thick, elasticity, ability to raise in folds (indicating emaciation).

.or loss of fluids), flabbiness, dryness, fragility, reaction to stimuli (dermatographia), moisture, if bloated, pasty, edematous, emphysematous (crepitus on pressure). Degree and localization of edema and emphysema.

Edema—Color (pale or cyanotic). Degree, localization.

(a) *Generalized Edema*—Chiefly in the dependent parts as in the retro-malleolar and *sacral* regions in circulatory disturbance. More generalized in renal edema but may be localized (often to lids). Edema of cachexia and severe anemia. Regional edema in venous stasis (is also cyanotic) as in thrombophlebitis, varices and stasis of the vena cava.

(b) *Localized Edema*—Inflammatory, toxic, angioneurotic. Collateral edema on the surface above a deep seated inflammatory process (see chest or abdomen) and frequently in such processes in the muscles or nerves (myalgia, neuralgia).

(c) *Acute Circumscribed Edema (Quincke)*—of the skin, often accompanied by effusions in the joints.

Color

(a) *Pallor*—Pseudo-anemia (pallor without corresponding anemia, findings in the blood), incomplete circulation of the blood in the skin, abnormally thick skin. Anemia (chlorosis with a tinge of green, pernicious anemia with a tint of yellow).

(b) *Redness*—Localized as in transitory dermatographia, hectic flush. Inflammatory redness in inflam-

mation of the skin or underlying structures. Result of atmospheric conditions (coach driver's face). Marked in erythremia.

(c) *Cyanosis*—General, localized as in acrocyanosis, local stasis (vena cava).

(d) *Icterus*—Sub-icterus, pale yellow, dark yellow to greenish (melasicterus). Examination of the scleræ and hard palate.

(e) *Pigmentation*—Generalized or local. Sunburn, result of chronic irritation (ulcus cruris, cutis vagantium, etc.), artificial after adhesive plaster, local heat or X-ray therapy. *Addison's disease* (see mucous membranes), arsenical pigmentation, displacement of pigment (leucoderma, vitiligo, chloasma uterinum).

(f) *Other Forms of Skin Pigmentation*—Yellow, due to picric acid poisoning, xanthosis of diabetes, karotin pigmentation (especially of the palmar and plantar surfaces). Smoke gray color in argyria, etc.

Hair—Degree, localization, type (masculine or feminine), condition of the hair.

Exanthemata—Efflorescences, scars, nodes. Neurofibromatosis, lipomatosis (*Dercum's disease*, granular form, forms *en plaques*). Metastasis.

Visible Mucous Membranes—Hemorrhages, pigmentations, etc., as in skin. *Addison's disease* (mucous membrane of mouth and lips).

Pulse, Respiration, Temperature

Pulse—At radial artery (see pages 12 and 14, for pulse at others).

1. *Position* (anatomical variations) — Course (straight, serpentine).
2. *Size* (congenital narrowing of the vessels)—Filling (poor filling in aortic stenosis).
3. *Condition of the Arterial Wall*—Normally soft and smooth. Ability to obliterate pulse by compression with fingers. Generalized thickening in increased tonus of the vascular musculature, in hypertrophy of the muscularis (also in young individuals), in luetic meso-arteritis and arterio-sclerosis. Localized thickenings as in necrosis of the media and calcification of this layer (“goose gullet artery”). Peri-arteritis nodosa.
4. *Height of Pulse Wave*—Pulsus altus, pulsus parvus, pulsus celer, pulsus tardus. So-called pseudocelerity, i.e., hopping pulse in arterio-sclerosis of the aorta, in peripheral hypotonia as seen in infectious disease, and in thyreotoxicosis, etc.
5. *Tension*—Use three fingers in which the third blocks the possible retrograde pulse from the arch while the first finger gradually increases the pressure from above. The middle finger palpates the pulse during the compression. The greater the required compression, the greater the pressure.
6. *Frequency*—Rate per minute. The rate in arrhythmia should be determined by auscultation of the heart (see imperfect contractions, page 10). Change in frequency in different positions of the body.

A. INCREASED FREQUENCY (*Tachycardia*)

Special Forms

Normotopic (sinus) tachycardia, rapid rate as in infectious diseases, thyreotoxicosis, neuroses, etc.

Heterotopic tachycardia in grouped extra systole as in auricular fibrillation or auricular flutter.

Periodic attacks of rapid rate in paroxysmal tachycardia.

B. DIMINISHED FREQUENCY (*Bradycardia*)

Sinus Bradycardia—Characterized by pulse intervals of the same length as seen in icterus and in certain forms of infectious diseases and after infections.

Vagus Bradycardia—Slow rate but not perfectly regular heart action as shown by graphic methods. Found in increased cerebral pressure or digitalis effect. Stimulation of the vagus in its peripheral course. Experimental vagus bradycardia by pressure on this nerve, during which the pressure is carefully made and gradually increased on the vagus as it lies behind the carotid. Pressure on the right is more effective than on the left. This should be done only with simultaneous control by auscultation of the heart as the heart may cease to beat in cases where there are changes in the myocardium.

Bradycardia Due to Imperfect Conduction (heart block or complete dissociation)—Pulse rate drops to 40 or below. Lesion of the stimulus conducting sys-

tem (bundle of *His*). Sometimes caused by stimulation of the vagus as by the effect of digitalis.

7. *Inequality*—Unequal height of the pulse waves.

8. *Arrhythmia*—The diagnosis of the finer arrhythmias is best determined by graphic methods. The changes discussed in this outline are those which can be determined by ordinary physical examination at the bedside.

The more important forms of cardiac irregularities.

A. *Pulsus irregularis respiratorius*—Sinus arrhythmia.

Regular increase of pulse rate during inspiration and slowing in expiration (variation of vagus tonus). Experimental increase of this phenomenon by pressure on the vagus (*see above*).

B. *Extrasystole*, as in groups in *pulsus bigeminus* and *trigeminus*. Characterized:

(a) By *pulsus intercidens*, in which a small, low wave occurs between two pulse waves which occur at the normal interval. The normal wave which follows this phenomenon is also smaller.

(b) As a result of a too early, small, pulse beat with a following, complete, compensatory pause (both tones corresponding to the extrasystole are found to be early when the heart is examined).

(c) By a pause unaccompanied by a palpable wave which is too early (incomplete extra-contraction of the left ventricle and which can be demonstrated at the heart only by an extrasystolic tone).

The wave following the pause in both "b" and "c" is very large and may be associated with a visible enlargement of the veins in the neck. (See tachycardia in regards to grouped extrasystole, page 8.) Certain cases of auricular and ventricular extrasystole may be differentiated by observation of the coincident pulsation of the venous pulse in the neck and by comparison with the auscultatory findings at the apex of the heart. The visible abnormal engorgement of the veins which corresponds to the extrasystole appears in auricular extrasystole at the same time or before the acoustic impression of the first tone of the extra beat is found. (Explanation: retardation of the visible perception as compared with the acoustic.) The abnormal engorgement of the veins occurs immediately after the first tone of the extrasystole in cases of ventricular extrasystole where the succeeding auricular contraction occurs during the premature contraction of the ventricle.

C. *Pulsus irregularis perpetuus*—Completely irregular pulse with similar action of the ventricle (auricular fibrillation or auricular flutter, depending on the frequency). Most frequently but not exclusively in mitral stenosis. (See tachycardia, page 8 and venous pulse, page 90.)

D. *Disturbances in conduction*—(a) *Lucian's periods*, larger pulse groups which are separated by pauses. The several intervals between the beats in one group gradually become smaller (gradual reduction in conductivity). This is accompanied by a continuous regu-

lar pulsation of the auricle which may be recognized by the venous pulsation in the neck.

(b) *Partial block*—A strikingly slow regular or irregular pulse in severe disturbances of conductivity. Each pulse beat corresponds to a ventricular contraction which may be demonstrated by palpation and auscultation. The auricle continues to beat independently in its own rhythm (audible auricular tones; the venous pulsation of the neck as a control).

(c) *Complete dissociation*—(See bradycardia, page 9.)

9. *Condition of the Pulse Quality on Both Sides of the Body* (especially at the radial and carotid arteries and relative to height and filling of the pulse wave and subsequent delay of same).—Physiological differences at the radial artery in variations and course are possible. Also in pathological conditions as in localized arteriosclerotic or inflammatory changes in the vessel wall in the region where the larger vessels begin or even more peripherally. Also in compression of an artery as by tumors, by a greatly enlarged left auricle as in mitral stenosis, etc., and in changes in the lumen of a vessel as in aneurysm. The occurrence of the radial pulse at different times in the two extremities (delay of the pulse) is seen in large aneurysms of the aorta, subclavian or brachial arteries. The filling on the normal side may be better or worse. There may be a difference in filling without delay.

10. *Dicrotism*—Two crests palpable in the periphe-

ral pulse wave during its descent, occurring in infectious diseases, thyreotoxicosis, etc.

11. *Paradoxism*—The pulse becomes smaller during inspiration.

(a) *Caused extra-thoracically* by clavicles which are especially low and which are pressed against the subclavian artery during inspiration.

(b) *Dynamic cause*—The thorax which is widened during inspiration aspirates blood in the lungs and allows a smaller quantity of blood to pass out from the lungs into the left heart (physiological paradoxism).

(c) *Mechanical cause*—In concretio cordis cum pericardio. The heart is covered by a thick layer of fibrous tissue and this, together with the filling of the lungs during inspiration, diminishes the space for the heart so that only a smaller quantity of blood can enter it at this time. The result is the expulsion of a smaller quantity of blood. (Pathognomonic paradoxia.)

Differentiation of these three forms—The first form disappears upon raising the arms. The pulse wave in the second is lowest at the beginning of inspiration and highest at the end of inspiration or beginning of expiration. The last form has its lowest pulse wave at the height of inspiration and the highest during the pause in breathing.

Respiration

1. *Type of breathing*—Costal, abdominal or costo-abdominal.

2. *Symmetry of breathing*—Determination by inspection, often better by placing a hand on each side of the thorax during inspiration. Recognition of local retractions as in peripneumonic retraction. (See infiltration, page 66.)

3. *Rate of breathing*—Oligopnea, polypnea (see dyspnea).

4. *Depth of breathing*—Normal, deep or superficial.

5. *Comparison of the duration of inspiration and expiration*.—Disturbance of this relation in inspiratory and expiratory dyspnea. Stenosis of the larger air passages often with expiratory dyspnea and stridor.

6. *Dyspnea* (difficult breathing) (*Sahli*)—It is rare to see a pure subjective dyspnea (neurasthenia) or pure objective dyspnea as in well compensated mitral lesions. Both types are usually combined. Dyspnea may occur in inspiration, expiration or both phases (inspiratory, expiratory and mixed dyspnea). It may be associated with breathing which is superficial and rapid, slow and deep or rapid and deep. Slow and deep breathing is common in hindrance at the upper air passages and is not seldom accompanied by an inspiratory stridor. Rapid and superficial breathing occurs in painful pleuritis sicca, trichinosis of the intercostal muscles or diaphragm, peritonitis, etc.

Special Forms of Breathing

(a) *Deep breathing (Kussmaul)* in acidosis—Frequently in diabetic coma, coma in cholera, salicylic acid poisoning, uremia, etc.

(b) *Periodic breathing (Cheyne-Stokes)*—Slowly increasing and then decreasing respiratory rate with a pause.

(c) *Biotic breathing*—Deep and slow with intervals of pause. Found in cerebral disturbances.

(d) *Paradoxical respiration*—A large effusion in the pleural cavity may cause the diaphragm to bulge toward the abdomen instead of being in the normal position of convexity towards the head. This may result in an in-drawing of the upper abdominal region when the diaphragm is shortened during inspiration instead of a bulging of the abdomen as occurs normally. This is still further exaggerated by the increased respiratory excursion of the healthy side and by a displacement of the mediastinum to that side. The navel is displaced toward the diseased side during each inspiration (paradoxical breathing).

The normal contraction of the diaphragm causes an equal pressure on the abdominal viscera and a symmetrical widening of the lower thoracic aperture. This may be impossible in adhesive processes within the thorax, especially if there are also extensive adhesive pericarditis and mediastinitis. The resulting contraction then serves but to bring together the anterior attachments at the sternum and the posterior attachments at the spine. The drawing-in of the lower sternum is the result (*Wenckebach*).

Litten's phenomenon—The shadow of the moving diaphragm may be seen on the lateral wall of the thorax during respiration, with unilateral illumination

at the foot of the bed. The phenomenon may be absent on one side in pleuritis, paralysis of the diaphragm, etc.

Temperature

May be taken in the axillary space, mouth or rectum. Usually taken per mouth. Should always be taken per mouth if the patient is undergoing out-door treatment. Nothing hot or cold should be taken per mouth for one-half hour before taking the temperature. Rectal temperature may be used as a control (hysteria, simulation).

Sources of error in rectal temperature; higher rectal temperatures after bodily motion, inflammatory disease of the pelvis or anal region.

An abnormally great difference between the axillary and rectal temperatures may, in some cases, point to inflammatory disease of the pelvis.

Oral and rectal temperature are several tenths of a degree higher than axillary.

Higher morning temperature should be watched for in subfebrile conditions. The average temperature of an individual is of importance in judging the height of a fever.

Types of fever; intermittent, continuous, remittent. The temperature curve should be plotted and notes should be made of chills and sweats.

Inspection and Palpation of the Various Regions

(a) HEAD

Size and Shape

Proportion of the portion of the head containing the brain to that of the face, as in hydrocephalus or acromegaly. Asymmetry. Palpation of the skull; sutures, protuberances, exostosis, circumscribed tumors, metastasis. Edema of the hairy scalp in inflammations and stasis (stasis of the vena cava).

Tenderness on percussion.

Tenderness on pressure at the places of exit of the nerves, also at the mastoid process, frontal and maxillary sinuses (collateral edema). Determine percussion note of the vault.

Eyeballs—Position as enophthalmus, exophthalmus, strabismus, conjugal deviation, weak convergence. Paresis of the lid, width of the palpebral fissure, lid edema, examination of the pupils.

Nose and Ears—Shape and size, condition of the lobules, formation of nodes.

Teeth—Shape and position, tenderness, looseness (caries), defects of the enamel.

Tongue—Size, shape, movement, atrophy, surface, coating, color (typhoid tongue with gray or brown centre and clean tip and margin. Coated tongue especially in stomach diseases. Strawberry tongue in scarlatina, etc.). Atrophy of the lingual mucous membrane as in pernicious anemia.

Mouth and Throat—Palpation of base of tongue. Soft and hard palate (shape, defects). Secretion of saliva. Oral mucous membrane (coating, ulceration, epithelial defects, pigmentations). Tonsils (size, crypts, plugged crypts, coating). Uvula, size, shape, position. Palpation of posterior pharyngeal wall. Granular appearance. Pharyngeal reflexes. Bulgings, etc.

(b) NECK

Length, width, contour.

Thyreoid gland—Size, shape, consistency, mobility on swallowing, thrills, pulsation.

Lymphglands—Detailed palpation, also in supra-clavicular fossæ. Size, shape, consistency; tenderness. Enlarged, isolated or grouped. Adherence to skin or underlying tissues. Infiltration, fistula.

Larynx—Size, tenderness, shape, voice. Determination of vocal fremitus anteriorly on thyreoid cartilage and with loud phonation. Absent or diminished fremitus on the side of recurrent paralysis. Swallowing movements (*Oliver-Cardarelli*). Pulsus laryngeus descendens (see page 77). Pulsus laryngeus ascendens more rare.

Neck Musculature—Development and tone.

Evidence of Passive Congestion—Veins and lymphatics (see pulse).

Cervical Vertebrae—Course, mobility, tenderness on percussion and pressure, cervical ribs.

(c) THORAX .

Lines of Orientation

Vertical—Anterior median line, sternal line at margin of os sternum, medio-clavicular line and para-sternal line (latter midway between the medio-clavicular and sternal lines). Anterior, middle and posterior axillary lines. Scapular line through the angle of the scapula. Interscapular line between the spine and inner border of the scapula. Para-vertebral line close along the spinal column. Posterior median line.

Horizontal—Ribs, intercostal spaces, spinous processes, angle and spine of the scapula.

Regions—Supra- and infra-clavicular fossæ, interscapular region, axillary region, supra- and infra-spinatus regions, hypochondrial region.

Dimensions—Length, breadth, depth of the entire thorax and its various portions. Position of the upper and shape of the lower thoracic apertures.

Breathing—(See page 12)—Type, frequency, symmetry, depth, duration of inspiration and expiration. Functioning of the various parts of the thorax. Local retraction during breathing.

Bulgings—Aneurysms, tumor. Shape of the supra- and infra-clavicular fossæ and of the jugular fossa, especially depth or bulging (supra-clavicular pulmonary emphysema) and filling out (glands, congested veins).

Skin—Condition of the veins, arterial and venous collaterals (isthmus stenosis, mediastinal tumor). Lo-

calized edema; collateral in emphysema, abscess and inflammatory mediastinal tumors or pleural tumors. Tenderness of the skin and muscles (see Zones of Head and Painful Pressure Points).

Ribs—Shape, course, floating and supernumerary ribs. Epigastric angle, width and depth of intercostal spaces. Bulging or resistance at the ribs, tenderness on percussion and pressure. Elasticity, abnormal softness, rigidity (osteomalacia, osteoporosis, metastasis). Very distinct diaphragmatic furrow in non-resistant ribs.

Sternum—Width, angulation, angle of *Louis*. Changes in shape. Tenderness on percussion and pressure, erosions, metastasis. Diseases of the bone marrow (anemia, leucemia).

Spine—Course and shape. Physiological lordosis of the cervical and lumbar vertebræ. Kyphosis of upper portion of thorax. Pathological kyphosis, lordosis, scoliosis. A moderate dextro-scoliosis is often seen in the upper part of the thorax.

Scoliosis—Twisting due to disease of the spine or secondary to pleuritic adhesions. Sciatica, psoas abscess, etc. Projection anteriorly, latterly or posteriorly of several vertebræ. Splitting of the spinous processes or vertebral arches (spina bifida, meningocele).

Mobility of spine in all directions. Abnormal, regional or general limitation of motion.

Tenderness of the entire spine, single vertebræ or segments:—

- (a) Overloading, especially in diseases of the vertebral bodies.
- (b) Active or passive movements (disease of several portions of the vertebræ and their joints).
- (c) Pressure.
- (d) On percussion as in spondylitis (rigidity of the neighboring musculature).
- (e) Prolonged application of warmth (application of heat to the spine increases pain in caries).

Spinalgia is determined by percussion of the spine with a percussion hammer. In acute and chronic processes of the bronchial glands, *Petruschky's* sign in tuberculosis of the glands of the upper portion of the chest. Tenderness of the spine in tumor metastasis and erosions (aneurysm).

Skin hyperesthesia as a segmental symptom (symptomatic intercostal neuralgia). Differentiation of bone tenderness from para-vertebral tenderness at the point of exit of the nerves. Test with short application of heat (hot test tubes). Increased sensitiveness to warmth especially in inflammatory processes.

APPENDIX

Types of Thorax

Thorax Paralyticus (asthenicus)

Flat, long, marked downward curve of the ribs posteriorly and upward curve anteriorly. Wide intercostal spaces, acute epigastric angle. Inferior thoracic aperture symmetrically narrower, upper thoracic aperture drops anteriorly. Abdomen flat, drawn in. Distance between crest of ilium and last ribs relatively small. A form of thorax paralyticus with kyphosis may be seen in severe, chronic pulmonary tuberculosis due partly to a secondary process, shrinkage and loss of fatty and muscular tissue.

Thorax Emphysematicus—Inspiratorius

Barrel shaped, short, wide, very deep. Bulges very much. Course of ribs horizontal. Intercostal spaces relatively narrow, wide epigastric angle. Upper thoracic aperture placed horizontally, upper border of sternum near larynx, relatively large distance between last rib and crest of ilium. Occasional retraction of the lower thoracic aperture during inspiration. Abdomen at same level, or bulges forward.

Thorax Pyriformis (Wenckebach)

In enteroptosis. Long upper portion bulges outward in both directions up to the fourth rib and again becomes flat and narrowed in the lower part (pear shaped). Upper thoracic aperture elevated, especially the sternal ends of the clavicles. The arms tend to hang more posteriorly.

Rachitic Thorax—Chicken breast, wedge-shaped, sternum bulges anteriorly.

Kypho-scoliotic Thorax—Acquired anomaly of sternum and ribs.

Shoemaker's Chest—Only the lower part of the sternum (xyphoid) drawn inwards. Ribs pushed inwards anteriorly.

Funnel Chest—A congenital deformity of the skeleton. Thorax and pelvis shortened in antero-posterior diameter. Lower sternum and epigastric region symmetrically retracted in a funnel shape. Upper abdomen drawn in and lower part bulging outward.

(d) ABDOMEN

General*Orientation*

See above for continuations of the vertical lines of orientation from the thorax. The transverse lines are the line of the costal arch, the rib line which connects the lowest point on each side of the arch, the umbilical line which runs horizontally through the navel and the iliac line which connects the crests of the ilium. The

posterior lines of orientation pass through the various spinous processes and are numbered according to the latter.

Regions

The epigastric region is bounded by the line of the costal arch and rib line, the mesogastric region by the rib and iliac lines and the hypogastric region by the iliac line and *Poupart's* ligament. The mesogastric region corresponds posteriorly to the lumbar region.

Inspection

Configuration of the abdomen and its relation to the level and size of the thorax. Globular, egg-shaped, pear-shaped. Bulging in the flanks, generalized distention.

Localized bulgings and unequal involvement of the various segments during respiration as, e.g., absence of movement during respiration of the lower right abdominal quadrant especially in appendicitis, but also in parametritis, pyosalpinx, torsion of an ovarian cyst or myoma and extra-uterine pregnancy.

Skin of the Abdomen

Striae, scars, localized edema, collateral veins (periumbilical caput madusæ in stasis of the portal vein and in the flanks in stasis of the vena cava). Determination of the direction of the current by compression with the finger; the part of the vein between the source of the blood and the compressing finger becomes engorged while the part between the compressing

finger and the ultimate destination of the blood in the vessel becomes collapsed.

The veins of the skin of the epigastric region may become visibly enlarged in a purely mechanical manner as a result of pressure by an enlarged liver against the rib margin. This must not be mistaken for stasis of the portal vein or vena cava.

Abdominal Musculature

Tension, rigidity, diastasis.—Reflexes of the abdominal walls and cremasteric region. Position, retraction or bulging (hernia) of the navel.

Palpation

Method—Generally in full supine position, half lateral position or standing with slight bending forward. Palpation with flat of hand (see palpation of the spleen), flat, thrusting or bimanual palpation. Localized or generalized muscular rigidity. The other portions of the abdomen should be first palpated if there is pain or tenderness in a certain area. Warm bath if marked rigidity.

General Palpation for Orientation—Hernia, abnormal resistance or tumor of the abdominal wall. Differentiation of the latter from intra-abdominal tumors by palpation during active contraction of the abdominal muscles by sitting up or raising the head while in the supine position. This will rule out suffusions, hematoma, tumors of the abdominal wall (*Nelaton, Schloffer*) and umbilical metastasis.

The abdominal aorta is often palpable in the epigastrium and the pulsation is more distinct in emaciation and enteroptosis. The sclerosed abdominal aorta may be palpated for a longer distance. Palpation of aneurysm of the abdominal aorta or abdominal vessels.

Demonstration of meteorism and ascites (see percussion). Diffuse air-cushion-like distension in meteorism. Trans-abdominal fluctuation in all directions in ascites. May be determined per rectum, vagina or patent inguinal ring. Similar findings sometimes in large, intra-abdominal unilocular cysts.

THE VARIOUS ABDOMINAL ORGANS

General orientation by systematic superficial and deep palpation of the organs normally reached by this method. Determination of size, shape, surface, consistency and respiratory and passive mobility of the palpable margin.

The size of palpable organs and resistance are often thought to be larger than they really are.

LIVER

Inspection—Skin in the liver region (see page 23). A considerably enlarged liver may be recognized by the bulging of the right hypochondrium and projection of the lower border of the ribs in this region.

Lower margin of the liver visible in emaciation, ptosis, enlargement of the organ and the condition of the liver surface may at times be seen. The visible enlargement may be of the entire organ, single lobes,

nodular enlargements or of the gall-bladder. Visibility of the respiratory excursion.

Palpation—Position, course, and condition of the lower border (rounded, sharp, irregular, etc.). Superficial consistency, palpable rubs, hydatid thrill.

The entire liver border is often palpable normally. Descent of the lower border in ptosis of the liver, low diaphragm or enlargement of the liver (determination of the lung-liver boundary by percussion). Sharp or rounded border (latter in passive congestion). Position of the notch between the lobes is variable but is usually between the right para-sternal line and medioclavicular line. Abnormal projections or depressions. *Ridel's lobe*. Asymmetrical enlargement of the lobes (left lobe often enlarged in syphilis).

Surface—Smooth (liver of passive congestion, amyloidosis, fatty liver, *Hanot's* cirrhosis, cirrhosis due to biliary stasis, some forms of hepatitis, etc.). Finely or coarsely granular surface (former in atrophic *Laennec's* cirrhosis or induration from chronic stasis of blood or bile and the coarse granulation is found in syphilis of the liver, cysts, echinococcus and metastasis of the liver).

Consistency—Normal, increased or decreased. Diffuse or circumscribed changes. Circumscribed fluctuations (soft metastasis, etc.), local pulsations (angioma) and diffuse pulsations (see pulsating liver).

Tenderness on pressure and percussion (best with a percussion hammer). Diffuse or localized. Circumscribed tenderness in the region of the incisura, some-

times best demonstrated with the patient on left side and thrusting fingers under the ribs (cholecystitis). Circumscribed tenderness in the median line as a part of the diffuse tenderness in diastasia recti and congestion of the liver. Same in inflammatory or purulent processes (abscess, perihepatitis with occasional per-hepatic rub).

Diffuse Tenderness—Passive congestion of the liver, especially increased in acute congestion and sometimes resembling localized peritonitis. Also in diffuse parenchymatous processes, catarrhal icterus, infectious icterus, hemolytic icterus, subacute yellow atrophy of the liver, etc.

Tenderness on percussion of the hepatic region with the ulnar side of the hand or tenderness on thrusting palpation at the borders of the ribs in inflammatory or purulent processes in or above the liver (subphrenic abscess with descent of the liver, edema or redness of the skin and bulging of the hypochondrium. (See percussion.)

PALPATION OF THE GALL-BLADDER

Hardly palpable under normal conditions. May be palpable under pathological conditions as a tense or hard resistance (hydrops of the gall-bladder, cholecystitis, peri-cholecystitis, stone formation, tumors). Palpation of the gall-bladder often difficult in inflammatory processes with rigidity or edema of the abdominal wall.

Differentiation of a palpable gall-bladder from a

kidney or other tumor of this region. Gall-bladder tumor may be pedicled or may be pushed laterally in pendulum manner. Distinct ballottement as in the kidney if the latter and the overlying gall-bladder are manipulated at the same time. Large gall-bladder tumors may show "lateral ballottement" if the posterior palpating hand is placed more outwardly on the back instead of near the spine. Tumescence and tumor of the gall-bladder usually show distinct respiratory excursion. (Method similar to palpation of the spleen.)

SPLEEN

Inspection—Forward bulging of the left hypochondrium in large splenic tumor (compare with liver).

The borders of the spleen and its notch may be visible in marked enlargement. The respiratory excursion of the spleen is also sometimes seen.

Palpation—Size, shape, course, consistency and condition of the borders.

Method—Patient in half right lateral position, abdominal musculature relaxed as much as possible and left arm on head. Also in supine and standing positions with slight stooping forward. The palpating hand is placed flatly on the abdomen, the finger tips towards the costal arch so that the lower pole of the spleen touches the tips of the fingers during deep inspiration. The palpating hand remains at rest. The fingers may be thrust under the ribs and the lower pole of the spleen may be felt under the ribs during

inspiration. This method may be aided by pushing the spleen forward from the left hypochondrium.

Note size and shape. Normal sized spleen not palpable except in descent of the diaphragm (pleuritic exudate, pneumothorax; etc.).

Symmetrical enlargement of the spleen (splenic tumor) in passive congestion, infectious diseases and diffuse parenchymatous changes in the spleen as in diseases of the blood. Metastasis, malignant tumors, etc. Notch in medial border prominent in marked enlargement. Length of the spleen in centimetres (distance between upper limit of splenic dullness and lower pole and not by measuring the part projecting beyond the ribs). Surface; smooth, nodular (localized tumors or cysts), palpable rubs (perisplenitis). Consistency; normal, diminished (acute splenic tumor); increased (chronic splenic tumor of the spleen). Tenderness on palpation and percussion. Respiratory excursion usually distinctly demonstrable.

Differentiation of splenic tumor from tumors of the splenic flexure, of the left kidney and adrenal, tail of the pancreas, tumors of the omentum, mesenteric glands and stomach.

KIDNEY

Inspection—Visible bulging only in marked enlargement of the organ (renal tumor, cysts, hydronephrosis).

Palpation—Method; always bimanual, supine position and in right and left lateral position.

Position—Right kidney normally lower than left and is more easily palpated even when normal. It is difficult to palpate the left kidney, even in some cases of ptosis (higher position, covered by colon). Reduction of ectopic kidney (see percussion).

Mobility of the kidneys—Especially marked in ptosis, floating kidney (degree of mobility depends on extent of bimanual grasp of the kidneys). Respiratory mobility (normally of slight degree).

Shape, size, consistency and condition of surface. Palpation of tumors, either unilateral or bilateral cystic kidney. Variation in size in hydronephrosis, fluctuation, etc.

Tenderness of the kidney region on palpation and percussion of the lumbar region with the ulnar side of the hand or fist. (See zones of Head.)

Collateral edema of the skin in the lumbar region (pyonephrosis, peri-renal inflammation). Tenderness on palpation also found in acute swelling (nephritis), renal stone, etc.

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Inspection and palpation of the region of the bladder. Filling of the bladder, abnormal tenderness (pericystitis mistaken for cysts or pregnancy and proved on catheterization). Contractibility of the bladder in nervous diseases.

STOMACH

Inspection—Bulging of the stomach in gastric metrorism, dilatation, stiffening. Gastric peristalsis and

anti-peristalsis. The change in size, etc., may be noted by marking horizontal and perpendicular lines on the abdomen and comparing the position, distention, etc., at various intervals. Peristaltic waves may be stimulated by gently striking the abdomen with a moist towel or use of ether spray. Visible tumors. Distention of stomach with soda bicarbonate and tartaric acid to make its contour visible. This may differentiate a long, narrow stomach with a low greater curvature (ptosis) from a stomach turned horizontally (dilatation). This may stimulate visible peristalsis. Effect on tumors (more or less distinct, displacement).

Palpation—(See abdominal tumors page 34).

Demonstration of clapotage by thrusting palpation of stomach. Tenderness (see pressure points and zones of *Head*, page 38).

INTESTINE

Inspection—Visible, physiological peristalsis in thin, relaxed abdominal walls. The bulging by distention of meteorism of the small bowel is peri-umbilical, of the colon in the right and left flanks and in the ileo-cecal region in atony or flatulence of the cecal portion of the colon. Differentiation of peristalsis of the small and large intestines. Tumors.

Palpation—Portions of the intestines often normally palpable such as the descending colon, sigmoid (abnormal distention above the symphysis and extending toward the ileo-cecal region) and the cecum (striking concavity at the ileo-cecal region in high position of

cecum). Palpable fecal masses (plastic and can be moulded by pressure). (See next part for abdominal tumors.)

TUMORS OF THE ABDOMEN NOT CAUSED BY

ENLARGEMENT OF AN ORGAN

Size, shape, surface, consistency, tenderness and pulsation.

Localization—In the abdominal walls, extra-peritoneally, intra-peritoneally, retro-peritoneally. Disappearance of intra- and retro-peritoneal tumors in tension of the abdominal wall (sitting up or raising the head). Position in relation to stomach, intestine (also after inflation of these) and to other organs.

Respiratory Excursion—Descent of tumors in inspiration if they are not fixed but are attached to organs which move on respiration. Most distinct in stomach, liver, transverse colon, spleen, omentum, and less marked in the kidney, mesenteric glands, cysts and retro-peritoneal tumors unless the tumors are of very large size.

Fixation During Expiration—The tumor is grasped from above in inspiration and it is attempted to hold it in that place during expiration. Failure to accomplish this speaks for direct or indirect fixation (adhesion of a tumor of the stomach to the liver) (*Nothnagel*).

General Passive Mobility—Especially marked in

tumors of the omentum and mesentery, pedicled cysts and myomata, etc.

Exclusion of the existence of an ectopic organ by demonstrating by palpation and percussion that the organ is in its normal position.

Demonstration on palpation and percussion of a connection with an abdominal organ or myoma of the uterus, tumor of the ovary, hypernephroma, intestinal tumor, gall-bladder tumor, etc. Border of the liver in tumor of the gall-bladder.

HERNIAL RINGS

Examination of the hernial rings; hernia inguinalis, femoralis, ischiadica, umbilicalis, abdominalis, etc. (hernia of the abdominal wall). Description of size and shape of hernial protrusion, contents, ability to reduce. Changes of the covering skin; redness, swelling, tenderness.

RECTUM

Inspection and digital examination.—Hemorrhoids, fistula, prolapse. Size and condition of the prostate. Position, size, shape of the uterus. Palpable and visible tumors.

Palpation of the pouch of Douglas.—Condition of the mucosa and its mobility over tumors. Palpable bulging in the pouch of *Douglas*; abscess, proctitis, appendicitis, tumors, ascites. Degree of contraction of the sphincter. Spasm or relaxation as a symptom, especially in paresis of the bowel (peritonitis). Shape,

size and filling of the ampulla. Fecal retention in torpor recti, dyschezia. Palpation of the sacrum.

GENITALIA

Size and development of the external genitalia. Gynecological examination of the uterus and adnexa, vaginal palpation and recognition of processes limited to the extra-genital parts (ectopic organs, abscesses, peri-appendiceal tumors, etc.).

(e) EXTREMITIES

Length of the extremities in relation to the trunk. Relatively long in large growth of eunuchoids and relatively short in chondro-dystrophy. Cartilaginous exostosis. Giant or dwarf types. Proportion of the various parts of the body.

Position of the extremities as slight flexation of the right hip and knee in peri-typhilitis and also in acute right-sided parametritis, pyosalpinx, torsion of a cyst or myoma; extra-uterine pregnancy.

Hypertrophic and atrophic processes of the skin (sclerodermia, nervous diseases, marasmus). Wave-like course of arteries and veins, aneurysm, varix. Local circulatory disturbances, local asphyxia, bluish discoloration or pallor, vascular changes from embolus, thrombus, changes in the vessel wall or functional disturbances like spasm or paresis of the vessels. Examination of the dorsalis pedis (pulse difficult to feel or absent in intermittent claudication).

Local edema—Stasis in the veins or lymph vessels (chronic lymphatic stasis or elephantiasis).

Local rise in temperature—Redness, swelling, differences in temperature as in hemiplegia, sciatica.

Determination of mobility or arrest of motion.

Deformities of the bones (exostosis, callus formation, tophi, Heberden's nodes, drumstick fingers).

—Shape of fingers and toes (changes in acromegaly). Shape and condition of the nails (fragility in tetany).

Joints—General configuration, especially unilateral enlargements in arthropathies resulting from nervous diseases (tabes, syringomyelia). Active and passive motion, partial or complete limitation of motion. Redness, abnormal pallor of the skin (tumor albus), swelling, local edema.

Tenderness on local pressure or movement.

Determination of fluctuation as a sign of fluid in the joint (ballottement of the patella).

Swelling about the joint—Condition of the tendon sheaths and serous sacs. Feeling of crackling or rubbing in the joints.

Condition of the musculature.—Development, atrophy, hypertrophy, pseudo-hypertrophy. Tone, consistency (like dough in myositis and as hard as bone in myositis ossificans). Tenderness, local infiltration in trichinosis, cysticercus. Muscle hematoma in hemorrhagic diathesis.

Active and passive mobility of the extremities and increased or decreased muscle tone.

Skin, tendon and periosteal reflexes.

APPENDIX

Hyperesthetic Zones of Head and Tender Points

Hyperesthetic segments of the skin, muscle, tendons, cartilage and bones may be found in various diseases of the organs, especially those of inflammatory nature (cholecystitis, appendicitis, etc.). These are the so-called zones of *Head* and often correspond to the radiating pains from these organs. The pain or tenderness goes from the organ to the spinal cord via the sympathetic fibres. The course is then via the sensory fibres of the posterior roots to the skin. The table on the following page shows these zones:

Organ	Nerve Segment	Localization of the Corresponding Zone on the Skin
Heart	Cervical 3 to Dorsal 8	From the supra- and infra-clavicular fossæ downwards to the 7th rib. Arm and forearm. Supraspinatus fossa on the back downwards to the level of the 8th thoracic vertebra.
Lungs	Cervical 3 and 4 Dorsal 3 to 9	From the supra- and infra-clavicular fossæ downwards to the costal border. Dorsally: from supraspinatus fossa downwards to the 11th dorsal vertebra. The arms same as above.
Stomach	Dorsal 7 to 9	From the level of the xyphoid to nearly at a horizontal level of the navel. Dorsally: from the 8th to the 11th dorsal vertebra.
Intestine	Dorsal 9 to 12	From horizontal line through navel to <i>Poupart's</i> ligament. Dorsally: from the level of the spine of the 12th dorsal vertebra to the level of the 4th lumbar vertebra.
Liver	Dorsal 7 to 10	From the 7th rib to the level of the navel. Dorsally: from the level of the 8th to 12th spine of the dorsal vertebra.
Kidney	Dorsal 10 to Lumbar 1.	From level of the navel to slightly below <i>Poupart's</i> ligament. Dorsally: from level of spine of 12th dorsal to the coccyx and gluteal folds.

The skin hyperesthesia may be demonstrated in its various areas by use of slight sticking with a pin or touching with a cold or hot object (test tubes filled with cold and hot water).

Some practically important hyperesthetic zones of *Head*.

The skin overlying inflamed tissues or organs is generally hyperesthetic but is not a zone of *Head* strictly speaking.

EXAMPLES OF ZONES OF HEAD

1. *Angina pectoris* (stenocardia, aortalgia)—Hyperalgesia of left side of thorax and inner side of the left arm and left side of neck.

2. *Appendicitis*—Hyperalgesia of the right hypogastrium.

3. *Cholelithiasis*—Hyperalgesia over the right costal arch and upper rectus.

4. *Nephrolithiasis*—Hyperalgesia of the back above the iliac crests and anteriorly of the abdomen along *Poupart's* ligaments.

5. *Pleural disease*—Hyperalgesia of the skin corresponding to the site of the lesion.

6. *Spondylitis*—Hyperesthesia over and to the sides of the place corresponding to the diseased area.

7. *Acute tonsillitis*—Hyperalgesia of the skin of the neck behind the jaw.

THE MOST IMPORTANT POINTS OF TENDERNESS

There are definite points which are tender in disease of deeply situated organs and which do not always lie over these organs. Tenderness of the organ itself is to be differentiated from the tenderness in the zone of *Head* and of the points of tenderness under discussion. This tenderness of the organ cannot be found if the overlying muscle is made tense.

The points of tenderness under discussion are found by pressure with the tip of the finger or striking with the percussion hammer. (Hyperesthesia of the skin without accompanying tenderness on percussion speaks for a functional disturbance.) The following points of tenderness are listed alphabetically according to the name of the author and the disease:

Alexander's—(see gastrophtosis in this chapter).

Aortalgia—Tenderness of the plexus in the left supra-clavicular fossa (*R. Schmidt*).

Appendicitis—1. Junction of middle and outer third of line from spine of the ilium to the navel (*McBurney*) ; 2. About 4 cm. from the navel on the before mentioned line (*Morris*) ; 3. The junction of the middle and right thirds of the interspinal line (*Lanz*) ; 4. Tenderness of the navel in the midline and often more distinct at 2 cm. below the navel if appendix is on left side (*Kümmel*) ; 5. Pain in the ileo-cecal region on gently stroking the hand from the sigmoid flexure towards the splenic flexure (*Rovsing*).

Blumberg—(See peritoneal irritation).

Boas—(See gastric ulcer, cholelithiasis).

Charcot—(See ovary, hysteria).

Chauffard—(See cholelithiasis).

Cholelithiasis—1. The upper segment of the right rectus abdominis (*Mackenzie*) ; 2. Pressure point under the right clavicle (*Chauffard*) ; 3. Two to three finger breadths to the right of the 12th thoracic vertebra. This tender spot often extends to the axillary line. No tender point to the left of the spine in contradistinction to gastric ulcer (*Boas, Gaultier*) ; 4. Tenderness of the phrenic as in diaphragmatic pleurisy. Located between the heads of the sternocleidomastoid (*Ramond*).

Gastroptosis—Tenderness in or near the middle line just below the xiphoid and more distinct on standing. Pain worse after drinking fluids. Disappears on pressure upwards with the hands (*A. Alexander*).

Hilus (tracheo-bronchial)—Glandular disease in tuberculosis and acute diseases of the upper air passages and lungs (tracheo-bronchitis, pneumonia). Tenderness on pressure and percussion of the first to fifth thoracic vertebræ (*Petruschky*).

Hysteria—Tenderness in the region of the ovaries (*Charcot*).

Sciatica—Tenderness over the sciatic foramen, mid-point between tuber ischii and trochanter.

Jaschke—(See obstipation and oophoritis).

Kümmel—(See appendicitis).

Lanz—(See appendicitis, also pyelitis and urethritis).

Lumbago—Tenderness of the longissimus dorsi.

MacBurney—(See appendicitis, also pyelitis and ureteritis).

MacKenzie—(See cholelithiasis, also duodenal ulcer).

Morris—(See appendicitis).

Mussy, Guenau de—(See diaphragmatic pleurisy).

Nephrolithiasis—Inner border of the psoas (see pyelitis) (*Ortner*).

Obstipation—1. Deep tenderness in the sigmoid flexure; 2. Chief point of tenderness just below the left sacro-iliac articulation in perisigmoiditis (chronic obstipation and left sided oophoritis) (*Jaschke*).

Oophoritis—Tenderness over the ovaries and just above the sacro-iliac articulation (*Jaschke*).

Ortner—(See nephrolithiasis).

Ovaries—(See hysteria).

Perisigmoiditis—Tenderness just above the left sacro-iliac articulation.

Peritoneal irritation—Moderate pain on deep pressure over the region and severe pain on suddenly taking away the hand (*Blumberg*).

Petruschky—(See hilus tuberculosis).

Pleuritis, diaphragmatic—Tenderness at the crossing of the para-sternal line and the prolongation of the 10th rib; 2. The upper intercostal spaces near the sternum; 3. Where the phrenic nerve turns around the scalenus between the two heads of the sternocleidomastoid (*Genau de Mussy*); 4. Between the ribs at the attachment of the diaphragm.

Pyelitis—Tenderness along the ureters to the kidneys. Deep tenderness in the region of the kidney. The skin hyperesthesia is the same (*Lanz* and *MacBurney*).

Ramond—(See cholelithiasis).

Rovsing—(See appendicitis).

5—Point of *von Noorden*; corresponds to *MacBurney's* point but is on the left side, in irritative conditions of the sigmoid (sigmoiditis, colica mucosa) and in hard scybala in the sigmoid.

Schmidt, R.—(See aortalgia).

Trigeminus neuralgia—Point of exit of the branches of the trigeminus (*Valleix*).

Ulcus ventriculæ—1. Tender point to the left of the spine near the 12th dorsal vertebra (*Boas*); 2. Upper middle and lower epigastrium, depending on the position of the ulcer (*Mackenzie*).

Ulcus duodeni—To the right of the midline in the epigastrium (*Mackenzie*).

Ureter—Tenderness in the region of the sacro-iliac articulation. Anteriorly at the intersection of the outer margin of the rectus and the horizontal line through the navel.

Ureteritis—Tenderness along the ureter to the kidney. Skin hyperesthesia analogous (*Lanz* and *MacBurney*).

Valleix—(See trigeminus).

PERCUSSION AND AUSCULTATION

I. Percussion

GENERAL

Method—The finger-finger percussion is generally used. The percussion must not be too strong. “Superficial percussion” (light percussion on a finger which is lightly placed on the part) is used in examination of parts which are superficially located, as, for example, the boundaries of the lungs. “Deep percussion” is used for organs which are deeply located as in the determination of the size of the heart. In this method moderate force is used in percussion on a finger firmly pressed against the part.

Percussion informs us of the air content and of the degree of tension of the walls of the air spaces (stomach, intestine, pulmonary alveoli). The boundaries of an organ may be established in this manner by determining the air content (as the heart and liver in contrast to the lung) (topographic percussion). The quality of the tones on both sides of the body may also be compared (comparative percussion).

Qualities of Tones

- | | |
|--|--|
| 1a. <i>Full</i> = loud, usually long and large vibrations. | 1b. <i>Empty</i> = soft, low. Short and small amplitude of the vibrations. |
| 2a. <i>High</i> = high rate of vibration. | 2b. <i>Deep</i> = low rate of vibration. |
| 3a. <i>Tympanitic</i> = distinct musical tone. | 3b. <i>Not tympanitic</i> . |
| 4a. <i>Metallic</i> = prominent, high tones in tympany. | |

Various combinations of the tones as relatively dull or highly tympanitic.

Generally, the first three qualities are used in description of the percussion tone. Example: full, moderately high, not tympanitic tone. This tone is normally heard over the lung. Loud, moderately deep tympanitic tone normally found in the space of *Traube*. Soft or low tone (absolute dullness), high, not tympanitic percussion tone as on percussion of the thigh.

II. Auscultation

GENERAL

Method—Direct auscultation with the superimposed ear or indirect with the aid of a stethoscope. The latter method is necessary to definitely localize sounds which are heard within a small area (breath sounds, heart tones).

The patient should breathe with the mouth open, slowly and deeply and with full expiration.

III. Special Physical Examination

LUNGS

A. *Percussion*

The moderately full and moderately high non-tympanic tone which is found on percussion of the normal lung will be called the "pulmonary tone." This tone becomes fuller and deeper toward the base of the lung.

Topographic percussion — Determination of the boundaries in a chest with normal configuration.

The pulmonary borders are determined by light percussion so that the tone of the lungs is not heard beyond the pulmonary borders.

The lower, anterior margin of the lungs (liver-lung margin) is found in the parasternal line on percussion, normally at the level of the sixth rib but not at this place on lying down or standing up. The liver-lung margin is in a general way dependent on the position of the diaphragm. This margin may be higher on standing than on lying down (the liver and diaphragm are pushed up by strong abdominal muscles), or the reverse may be true if the abdominal walls are flaccid, especially in splanchnoptosis. The relations are more easily determined on the right side where percussion is more useful.

It is best to have the patient sit on a stool instead of in bed in order to get most benefit from the changes in tone on percussion.

*Topographic Percussion: Determination of Boundaries**Anteriorly*

RIGHT			LEFT		
Middle Axillary Line	Medio-clavicular Line	Parasternal Line	Parasternal Line	Medioclavicular Line	Middle Axillary Line
8th-9th ribs	Upper border 6th rib	Upper border 6th rib	4th rib	Lower border 4th rib	8th-9th rib, but usually lower than on right side

Posteriorly

RIGHT			LEFT		
Scapular Line	Paravertebral Line	Scapular Line	Scapular Line	Scapular Line	Scapular Line
Spine of 11th to 12th dorsal vertebra. Usually higher than on left.	About one fingerbreadth higher than in the scapular line.	Spine of the 11th-12th dorsal vertebra.			

The borders of the lung which overlie the heart run from the attachment of the 5th costal cartilage on the left side, upwards and along the left sternal border to the 4th rib and then in a diagonal curve, downwards and outwards to the 5th intercostal space in the medio-clavicular line. This is the so-called area of absolute or superficial dullness according to the old nomenclature.

The borders of the lungs posteriorly are found at the level of the spines of the 11th and 12th dorsal vertebræ (about a hand's breadth under the angle of the scapula). The right side is usually somewhat higher than the left (liver). The borders of the lungs in the long and narrow thorax are somewhat lower and are a little higher in the short wide thorax. (See page 80 for diminished volume of lungs.)

The upper border of the lung can generally be determined only in a few places. The position of the apices and the projection of the apical field on the upper and posterior surfaces of the thorax are determined by topographic percussion.

Special Methods of Percussing the Apices of the Lungs

1. *Jagic's triangle*—The base of the triangle is a horizontal line between the spines of the first and second thoracic vertebræ. A point, three finger-breadths distant from the median line and on the base of the triangle is marked on each side. Lines are drawn from these points to the lower margin of the hair at the median line, forming the sides of the tri-

angle. These boundaries normally cut across the borders of the pulmonary apices at the upper margin of the vertebra prominens if the patient stoops slightly forward.

2. *Krönig's Fields*—These correspond to a projection of the lung apices, are band-like and pass across the trapezius from anteriorly to posteriorly. The zone of the pulmonary tone is determined at the highest point of the trapezius contour and from the neck toward the acromion process. A symmetrical upper chest is indispensable for proper interpretation of these findings.

Respiratory excursion—Determination of the size of the complementary space by determining the margins of the lungs in extreme inspiration and expiration. The respiratory excursion is determined in this way along all the lines of orientation anteriorly, laterally and posteriorly. It is also well to compare the respiratory excursion in the mid-axillary line during the supine and lateral positions.

The complementary space or respiratory excursion is diminished in pleural adhesions and in abnormally high or low position of the diaphragm as in bronchospasm or pulmonary emphysema. The left lower margin of the lung in the axillary line (lung-spleen margin) may be higher in adhesive changes of the pericardium and of the adjoining portions of the mediastinum and pleura when examined in the right lateral position. This is contrary to the normal change on change of position.

There is no respiratory excursion of the upper margins of the lungs but there is increased tympany during inspiration at the middle of the apex field in the supraspinatus fossa. There is also tympany during expiration toward the upper margin of the apex of the lung.

The upper margin of the apex becomes more tympanitic normally if the patient stoops forward. The percussion tone becomes deeper and the upper margin of the lung frequently shifts cranially (*Koranyi*).

Comparative Percussion

Comparison of the tones over symmetrical parts of the body at the same levels and same distances from the median line. This is possible only in symmetrical thorax, equal muscular tension and symmetrical position of the fingers on the parts. Moderately strong percussion is used in both supra-spinatus fossæ, about three finger breadths to the side of the spine and at a level of a horizontal line passing between the spines of the first and second thoracic vertebræ. The thorax is then percussed downwards from these areas on both sides and along the interscapular lines. The pulmonary areas below the angle of the scapula are percussed along the scapular lines. The percussion is then carried along the axillary lines, then anteriorly in the supra- and infra-clavicular fossæ, in the second intercostal spaces along the medio-clavicular lines on the left and right sides and in the axillary spaces

beginning at the folds of these spaces and going downwards.

There is often a slight impairment of resonance on the right and left sides. This may be caused by a difference in the development of the musculature or condition of the tension of the muscles on the two sides.

There is often a slight impairment of resonance on the right side even if the air content is the same in both sides at symmetrical places. This is found in the right interscapular space and right supraspinatus fossa (physiological dextro-scoliosis at the level of the interscapular region). Resonance is impaired by underlying organs as the heart or liver. The lower posterior region on the right side is sometimes duller as a result of the presence of the liver.

This percussion of all parts with moderately strong force may be followed by percussion with various degrees of force.

It must be remembered that edema of the skin of the back and front of the chest in nephritis or cardiac weakness or collateral inflammatory edema at this place may cause dullness on percussion and may lead to mistakes. The percussion tone is normally somewhat duller in the region of the lower, right half of the thorax with moderately strong percussion and especially while sitting. This is caused by an elevation of the diaphragm and the effect of the liver which is under it.

CHANGES IN THE PERCUSSION TONE

Pathological Dullness*

A. DEEP PERCUSSION

1. *Absolute Dullness*—In large effusions of fluid (exudate, transudate, hematoma), thick fibrous pleuritis, tumors between the lungs and chest wall, pleural tumors or tumors which extend from the lung). Infiltrating and solid tumors of the lung. New formations against the chest wall such as aneurysms, neoplasms, gland tumors, large substernal struma, etc. Also in occasional cases of inflammatory infiltrations (pneumonia) with coincident plugging of the corresponding bronchi (*Grancher*).

2. *Intense But Not Absolute Dullness*—Frequently with a slight tympanitic ring in infiltrations such as croupous and caseous pneumonia, denser tuberculous infiltration, compression atelectasis (as above the effusion and with more marked tympany), over deep-seated, new formations which do not contain air as tumors, enlarged organs as the heart, aneurysms, pericardial exudate and also in high diaphragm, and over smaller pleuritic effusions which give absolute dullness on light percussion.

* The tone over an area of dullness of the lungs is also somewhat higher pitched.

3. Relative dullness in superficially or deeply placed parts which do not contain air such as infiltrations, infarcts and other conditions mentioned in paragraph 2 as well as in larger but deep seated areas which do not contain air.

B. LIGHT PERCUSSION

1. *Absolute dullness* in interposition of a medium which does not contain air and which is not very thick (superficial foci of infiltration, fibrous masses and tumors of the pleura, small free or circumscribed effusions, thickenings of the chest wall), in edema of the skin and thickenings of the bones or muscles.

2. *Relative dullness* in diminished air content of the superficial parts. The percussion tone in pleural effusions and fibrous pleuritis may give relative dullness with moderately strong percussion and absolute dullness with light percussion and both may be found over the same area under these conditions. Deep seated foci of thickening may give a normal tone on light percussion and relative dullness on moderately strong percussion.

The Occurrence of a Tympanitic Tone Over the Lungs

Percussion, especially of the lower half of the left side posteriorly and in the axillary region may produce a tympanitic quality as a result of accompanying vibration of air-containing abdominal organs such as the stomach or colon. This is especially likely in mod-

erately strong percussion. The boundaries of the lungs in such cases should be determined with light percussion.

1. In relaxation of the lung as in the vicinity of foci of thickening, at the border of large pleural effusions and also in distant parts of the lung as in the supra- and infra-clavicular spaces and the second intercostal space anteriorly in large pleural effusions.
2. Over large spaces containing air.
 - (a) In intrapulmonary areas as cavities of any origin.
 - (b) Pleural, mediastinal and subdiaphragmatic spaces as under certain conditions in pneumothorax, subphrenic gas abscess, diverticulum of the oesophagus containing air, diaphragmatic hernia, eventration, etc.

Skin emphysema may cause tympany on percussion.

Metallic Percussion Tone

Over hollow cavities in the lungs containing air and with moderate or marked tension of the walls which must be smooth. These cavities either do not communicate at all externally or only through very narrow channels (cavities, pneumothorax). (See pleximeter percussion, page 61.)

Cracked pot sound; a sign of stenosis in open cavities or valve-pneumothorax. Normally on strong percussion of a very delicate thorax.

APPENDIX

Percussion of the paravertebral and interscapular regions.

Comparative, moderately strong percussion close to and along the spine.

There is frequently a softer tone normally on the right side at the level of the spine of the third thoracic vertebra and for a variable extent. It is indefinitely limited at its external border. This slight dullness may be continued to the interscapular space and is then due to the better developed musculature (analogous change on the left side in the left handed) or it may be due to physiological dextro-scoliosis.

Pathological findings as dullness and increased resonance in displacement of the entire mediastinum. Demonstration of the displacement of the mediastinum by percussion. If it shifted toward the healthy side in paralysis of the diaphragm and toward the diseased side in stenosis of the bronchus, etc.

A. A comparatively sharply circumscribed zone of dullness in dilatation of the aorta, especially of the ascending arch. It is found to the right, near the spine at the level of the 1st, 2nd and sometimes the 3rd thoracic vertebra, is about 2 fingerbreadths wide and 4 fingerbreadths long and is sharply limited externally (*Elias*).

B. Circular zone, para-vertebral on the healthy side in interlobar empyema and at the level of the area of dullness (*Ortner*).

C. Para-vertebral dullness to the left of the lower part of the spine in displacement and dilatation of the descending aorta.

D. Triangle of dullness on the healthy side in pleural effusion (see pleuritis, page 72) (*Koranyi*).

E. Triangular zone of tympany on the diseased side between the upper border of the area of dullness and the spine (*Garland*). This triangle of *Garland* cannot be differentiated on light percussion from pleuritic dullness. (Bilateral in effusion of both sides, see page 74.)

F. Zones of impaired resonance to the left and right of the spine in areas of thickening in the region of the hilus of the lung.

G. Zones of dullness at various levels in the para-vertebral region in diverticulum of the oesophagus and to the right and below, in diffuse dilatation of the oesophagus. Variation of the tone depending on the condition of filling of the diverticulum. Also unilateral or bilateral in large carcinomata of the oesophagus (*Luger*).

H. Para-vertebral zones of tympany on the healthy side in pneumothorax (*Luger*).

I. Para-vertebral tympany on the diseased side in shrinking pleuritic processes with effusion.

Dorsal zones of dullness due to the auricles (see page 102).

AUSCULTATION

I. Breath Sounds

Vesicular inspiration and a soft, blowing expiration is normally heard over the lungs. The second phase is shorter. Expiration is normally louder, more rich in tones and almost bronchial in the medial portion of the right apical region close to the spine and in the para-vertebral region down to the 4th or 5th thoracic vertebra. Similar findings may be present in the corresponding left para-vertebral space.

PATHOLOGICAL BREATH SOUNDS

The normal breath sound may be changed from the point of view of duration of the two phases, quality, loudness and duration of the entire cycle. The two chief types are vesicular and bronchial breathing.

A. Pathologically Changed Vesicular Breathing

1. *Diminished vesicular breathing* in decreased area-tion of the various parts of the lung or in poor conduction of the breath sound to the surface of the thorax (effusion, thickening, tumor, changes in the thorax wall, etc.).

2. *Abnormally prolonged expiration* and usually sharp, in narrowing of the bronchial tree by bronchospasm (bronchial asthma), accumulation of secretion,

partial blocking of the bronchus by a foreign body, *volumen pulmonum auctum* and in emphysema.

3. *Sharp inspiration*, usually with coincident sharp expiration in swelling of the bronchial mucous membrane (catarrh).

4. *Raw (gutteral) breathing* in swelling of the mucous membrane and moderate increase of thin secretion.

5. *Cog-wheel vesicular breathing* in unequal increase and decrease of the air current (moderate catarrh). (See systolic vesicular breathing, page 87 and page 113 [pulmonary insufficiency]).

B. Bronchial Breathing

Bronchial breathing is heard over infiltrated or compressed areas of the lung (airless alveoli), over hollow spaces which communicate with the bronchial tree and over adjoining healthy lung, in which case it becomes weaker as the distance from the diseased part is increased.

The bronchial breathing may be distinctly metallic in large cavities with smooth walls. It may also be heard beyond the actual phase of breathing (amphoric breathing). The bronchial breathing is higher and louder over infiltration (lobar pneumonia) than over compression.

C. Consonance Breathing

The breath sound may approach a bronchial character (broncho-vesicular or consonance breathing)

over smaller areas of thickening, especially in the upper lobe and in the apices.

D. *Mixed Breathing*

The two phases of breathing may not show the same type of breath sound. There may be inspiratory vesicular and expiratory bronchial breathing over distant or deep-seated foci.

E. *Metamorphosing Breathing*

Change of the type of breath sound during the same phase of respiration. Inspiration may begin with vesicular and end with bronchial breathing (over cavities).

II. ACCESSORY SOUNDS

A. *Rales*

Often heard only after coughing a little.

DRY	MOIST
Purring, whistling, crackling, etc. (ringing or not ringing)	Fine, medium, coarse (ringing or not ringing)

There is a consonant (ringing) character of the rales if they are moist and arise in bronchi or hollow spaces which are surrounded by tissues that do not contain air as in thickening or compression. A similar ringing character may sometimes be heard under similar conditions with dry rales. They are of diagnostic value according to the location (cavity at the apex, bronchiectasis at the base, etc.).

Fine crepitant rales are heard in expansion of collapsed or abnormally moist alveoli which did not previously contain air (atelectasis, pneumonia in the stage of engorgement). These rales are heard at the height of inspiration. They may also be heard at times during the first few deep breaths in the lower parts of the lung when the respiration was superficial for a long time previously. The rales under these conditions disappear after continued deep breathing.

Rubs

These occur in the presence of raw surfaces of the pleura when one layer rubs against the other. This

may be due to abnormal drying, fibrinous inflammation, tumor, etc. They seem to be near to the ear and show all varieties from soft rubbing to the sound produced by creaking leather. They may occur in inspiration or expiration without being strictly limited to the beginning or end of the breathing phases. They are usually not changed after coughing but become softer after repeated deep breathing and may even disappear. They may be made more distinct by pressure with the stethoscope. Pain may be produced by such pressure. Pleuro-pericardial and pericardial rubs (see page 87).

III. AUSCULTATION OF THE VOICE

Direct auscultation of the lungs is performed for this procedure. The ear is placed on the chest and the opposite ear is stopped up with the finger and the patient says such words as ninety-nine, sixty-six, etc., and then whispers such words as thirty-six, etc.

1. *Loud spoken voice*—The spoken words are heard as somewhat softer over the lungs normally, but the words are distinct and have the same tone. The voice is heard loudest over the upper regions of the lungs and in the para-vertebral regions. The spoken voice becomes weaker under the same conditions as diminished breath sounds (see page 57).

Increased and “booming” over large areas of lung which is poor in air content (infiltration, compression). The voice takes on a bleating character (aegophony) at the upper limits of a pleural effusion.

The patient is instructed to say the vowel “U” softly and for a prolonged period of time. Normally the sound which is heard over the lungs is like an “a” but it is changed to “ah” over infiltrated or compressed areas of lung or over large pleural effusions (*Karplus*).

2. *Whispered bronchophony* (whispered voice)—The whispered voice is normally heard as an even tone, without resonance and ending sharply with the end of phonation. This is heard over the upper lobes

and in the para-vertebral spaces to the 5th or 6th thoracic vertebra. The tone becomes very soft and can hardly be heard over the lower lobes. The whispered voice becomes loud, high and distinctly resonant over areas not containing air, especially deep-seated foci of thickening, even if these areas are small. The tone may be somewhat metallic in pneumothorax or cavity formation. Thickened pleura and extensive pleural effusions do not as a general rule cause whisper-bronchophony of an increased degree but such may be the case when the change comes from the depths, especially from the upper parts of the effusion. The same finding may be present in thickened pleura with coincident thickening or induration of the pulmonary tissue.

Auscultation of the voice over the apices does not give reliable results.

Combined Methods

COINCIDENT PERCUSSION AND AUSCULTATION

1. *Pleximeter percussion*—A distinct metallic tone may be heard over hollow cavities containing air (pneumothorax cavities) on auscultation near an area which is percussed with the aid of a pleximeter and hard object (percussion hammer). The stethoscope must be placed near the pleximeter. The normal tone is soft and without a metallic ring. Control by using the method on the corresponding area on the opposite side.

2. *Coin Sound*—This is produced by placing a coin

on a part of the chest, preferably the posterior wall, and gently striking the coin with another one. The stethoscope or ear is placed on the opposite aspect of the thorax, the anterior. Normally the sound which is heard is without any ringing tone. The same is found over compressed or infiltrated parts of the lung. There is a metallic ringing sound over effusions and completely airless tissues (tumor, *Grancher's pneumonia*). The sound may be like a bell in pneumothorax and the same phenomenon may be heard at times over large cavities.

The coin sound is normally heard over the region of liver dullness and care must be used that neither the site of auscultation nor that of the coin are near the area of liver dullness.

C. Palpation

Asymmetry of breathing (see breathing, page 12)—Palpable rubs or rales and conducted palpable phenomena from the heart and vascular systems. The splash of freely movable fluid in large spaces containing air may be felt on shaking the body (sero-pneumothorax).

Vocal Fremitus

Vocal fremitus is determined by placing the hands or finger tips over the parts of the chest to be examined and by having the patient say loud words as ninety-nine, etc. It may also be performed by placing a rounded retort (flask) over the parts to be tested.

Deep phonation is best in testing the lower lobes and higher tones for the upper lobes. Vocal fremitus is often weak or absent over the lower lobes in women.

Vocal fremitus is diminished if there is an intervening fluid or solid mass between the lung and chest wall (thick pleura, tumor, edema, etc.). The fremitus is increased if the conduction to the surface of the chest is favored by airless parts of lung around the bronchus (infiltration, compression). The method is of value only if the differences are great.

APPENDIX

PERCUSSION AND AUSCULTATION OF THE SPINAL COLUMN

Method—Direct percussion of the spines of the vertebræ with ordinary finger percussion.

The normal tone over the spines of the 1st, 2nd and 3rd thoracic vertebræ is dull. It is somewhat resonant and often slightly tympanitic over the 4th and then becomes more dull over the 5th to become more resonant again towards the 11th or 12th thoracic vertebra.

The percussion tone over the spine in young individuals with an elastic thorax is often more sonorous (box tone) and louder than over the neighboring parts of the lung.

Enlarged glands, thickened fibrous mediastinitis, mediastinal tumor, etc., in the posterior mediastinum cause a dull sound on percussion.

AUSCULTATION OF THE WHISPERED VOICE

Whisper bronchophony in adults is normally found up to the spine of the 2nd or 3rd thoracic vertebra. Whisper bronchophony from the 3rd vertebra downwards is always a pathological finding (improved conduction of the sound to the surface of the thorax by

enlarged tracheo-bronchial or mediastinal glands as caused by inflammatory or neoplastic processes (tuberculosis, lymphogranuloma, sarcoma, etc.). Spinalgia is often found in these conditions.

Heart tones and murmurs may also be heard over the spine (see page 115).

DIAGNOSTIC VALUE OF SOME OF THE PHYSICAL FINDINGS

Present in the Lungs

A. FOCI OF THICKENING IN THE LUNGS

Inspection—Large foci produce diminished respiratory excursion of moderate degree and no bulging or abnormal retraction of the intercostal spaces over the diseased parts. There may be inspiratory drawing in of the chest.

Percussion—Dullness of variable intensity, shape and extent, depending on the position and size of the focus of thickening (corresponds to the boundaries of the lobes in lobar thickenings). The dullness never extends beyond the normal borders of the lung in contradistinction to effusions of the pleura.

The foci of thickening do not displace the heart or mediastinum and do not produce any appreciable displacement of the diaphragm.

A tympanitic quality is present in the vicinity of the focus of thickening and in the zone of dullness itself in centrally placed foci. The dullness is seldom absolute even in large foci and does not resemble the tone heard over effusions or tumors of large size.

Auscultation—All degrees of consonance breathing

to bronchial breathing and often associated with all sorts of rales, especially ringing rales.

Vocal Fremitus—Loud and the whisper-bronchophony increased. The latter is a very good method for demonstrating small foci of thickening in the lung. The coin sound is negative.

APPENDIX

Physical Signs in Foci of Tuberculosis of the Lungs

Physical Examination of the Apices—Topographical percussion (see page 47). Dullness of the apical region is caused by diminished air in these parts. This may result from an area of thickening or from diminished volume as from pressure from a neighboring organ (struma), or by pleural effusion of the same side and in mitral stenosis (left auricle, bronchus stenosis).

The following signs are found in the various stages and varieties of pulmonary tuberculosis:

(a) *Pneumonic form* (caseous thickening)—No sign of shrinkage of thorax, no constant in-drawing. There are inspiratory in-drawing (peripneumonic in-drawing), massive dullness, consonance to bronchial breathing, increased vocal fremitus, whisper bronchophony and usually many ringing rales.

(b) *Nodular form*—Dullness of variable intensity and often with a tympanitic ring. *Auscultation*: all degrees from raw breathing with prolonged expiration to consonance breathing (frequently diminished, especially with coincident fibrous thickening of the pleura). Genuine bronchial breathing only in cases of large confluent, nodular foci. *Rales*: small or me-

dium sized and often ringing. The former is frequent in localization of the process to the apex while ringing rales come from the larger bronchi and cavities.

(c) *Cirrhotic* (shrinking, indurative) form—Sinking-in of the spaces depending on the location of the focus as in the supra- or infra-clavicular fossæ or intercostal space. Usually intense dullness, especially on light percussion and usually diminished breathing with soft consonance breathing and a few rales. Medium or coarse rales, often ringing in nature in bronchiectasis. High position of the anterior left pulmonary margin caused by retraction of the upper lobe which covers the base of the heart and with resulting denudation of the pulmonic region (see HEART, page 106). Closure of the pulmonary valves palpable with loud second pulmonic. Musculature of the neck on the diseased side atrophic and the muscle tone of the portion overlying the focus of shrinkage is diminished (*Pottenger*) in comparison to the increased tone of the overlying muscle in fresh, acute processes.

(d) *Miliary tuberculosis of the lung*—Diffuse, hematogenous deposit of miliary tubercles in all parts of the lungs as a result of entrance of a large number of tuberculosis bacilli in the blood.

Percussion—There is sometimes a slight tympanitic ring to the tone over the lungs. Lung margins low, considerable covering of the heart (moderate volumen pulmonum, differentiate from typhoid). *Auscultation*: the breath sounds may be normal but there is frequently prolonged expiration and raw or sharp

inspiration. Fine rales or dry crepitant rales may sometimes be heard.

(e) *Cavernous form*—Cavernous formation in caseous pneumonia as well as in the nodular type. Dullness of variable degree with a tympanitic ring in places, especially at the spot of most intense dullness (in contradistinction to a focus of infiltration or pleural effusion in which the tympany is more at the borders of the dullness). Coarse, ringing rales are the most important finding. (See the following part for other signs.)

B. Symptoms of Cavity Formation in the Lungs

Tuberculous or bronchiectatic cavities or cavities resulting from abscess or gangrene of the lung.

Percussion—Variable, sometimes there is only dullness with change to resonance or tympany upon expectoration of large quantities.

Change of tone on change of position (*Gerhardt*). Changes in the level and volume of the tone. Examine in the sitting posture and when on back and abdomen.

Change of tone on opening and closing the mouth (*Wintrich*). Change of tone in expiration and inspiration (*Friedreich*). The two latter signs are not very reliable.

Metallic ring with pleximeter percussion in large, smooth-walled cavities containing but little secretion.

Cracked pot sound, clinking and tympany. The latter is also found in relaxation in the vicinity of infil-

trated portions of the lung and normally in children and young persons if the mouth is open.

Auscultation—Coarse, ringing rales with a metallic character (reliable sound of cavity), frequently accompanied by bronchial or amphoric inspiration and expiration. Loud whisper bronchophony with a metallic ring. Loud bronchophony (spoken voice) often similar to aegophony. The change of findings on change of position is characteristic for cavity. Examine with the patient in the abdominal position.

The various auscultatory phenomena may be much diminished or absent in plugging of a bronchus. So-called pseudo-cavernous signs may be found in the region of the trachea and large bronchi in the infra-clavicular and interscapular spaces if there is considerable secretion. The recognition of a genuine cavity in the infra-clavicular region is possible by auscultation of the zone of tympany and coincident percussion of the trachea. Transmission of this sound towards the place of auscultation speaks for a cavity not far from the bronchial tree and communicating with it.

C. Pleural Effusion

The diseased side which is usually bulging ordinarily lags on respiration. The intercostal spaces bulge and appear widened. Absolute dullness with increased sense of resistance over the effusion. The overlying, compressed part of the lung gives a dull tympanitic sound. Marked tympany is frequent anteriorly, under the clavicle and on the diseased side. The area of

dullness is larger with light percussion than with strong. The dullness of the upper portion on strong percussion is not absolute because of the wedge shape of the effusion. (See *Garland's triangle*, page 55.) The upper border of the effusion descends obliquely as it approaches anteriorly, *Demoisecu-Elliott* line. It is only in very large transudates or exudates that the upper line tends to become horizontal. Effusions produce a bulging of the walls and also the intercostal spaces, mediastinum and diaphragm causing a narrowing of the space of *Traube* from above and displacement of the neighboring organs as the heart, liver and spleen. The upper abdomen on the diseased side does not bulge forward as is usually the case during inspiration but is drawn inwards (paradoxical breathing, page 14), in high grade unilateral pleural effusions in which the diaphragm is pushed markedly downwards or is even palpable under the rib margin. There is but slight shifting of the boundaries of the effusion on change of position if due to exudate and then only in the early stages. The shifting is more complete with transudate and is always present if there is coincident pneumothorax.

The apex of the lung on the same side as the effusion is often dull on percussion without there being pathological changes in the lung tissue but the other signs of involvement of the apex are absent.

Auscultation—The breath sounds over the effusion are weak. This is more marked in the lower regions, to complete absence in the region at the base. The

degree depends on the volume of the effusion. There may be distinct whisper bronchophony over the effusion of any sort (serous or purulent), *Bacelli's phenomenon*. This may be louder in the upper parts than in the lower due to the compression of the lung. Loud bronchophony is diminished over the lower parts. Aegophony is found in the upper portions in variable degree. Vocal fremitus diminished. Compression breathing at the upper margins of the effusion, decreasing, soft consonance breathing to genuine but soft bronchial breathing, increased bronchophony for the whispered and spoken voice. Auscultation over the zone of compression shows a few fine crepitant and other fine rales. Pleural rub often heard at the margin of the effusion. Vocal fremitus often increased here (compression).

A right angled triangle of dullness may be found in the para-vertebral region in the lower part of the healthy side in pleural effusion. This triangle is absent in thickening of the pleura without effusion and in foci of infiltration.

The upper, para-vertebral portion of the area of dullness has a louder tone on moderately strong percussion over a triangular area than the neighboring lateral part (*Garland's triangle*).

Sacculated exudate—Zones of absolute dullness of variable shape and localization with changing findings on auscultation. The findings correspond in general to those of exudate. The dullness is often demonstrable only on light percussion (thin fluid).

Interlobar exudate (often empyema). Dullness of variable shape and extent and may be relative or absolute, depending on the extent of the exudate and its proximity to the chest wall. It is often like a stripe or wedge in shape, following the interlobar fissure and with the tip at the spine. The upper and lower margins of dullness run anteriorly and downwards, and usually diverge so that the wider part of the dullness is in the axillary space. This dullness extends over the entire lower part of the thorax and cannot be differentiated from interlobar dullness if there is a coincident, complicating, symptomatic exudate and also in compression and edema of the lung below the effusion (X-ray examination is very necessary in such cases as well as superficial and deep exploratory puncture). The para-vertebral circular segment is found near the spine (*Ortner*). (See page 55.)

PLEURITIS DIAPHRAGMATICA

Dry, fibrinous, diaphragmatic pleuritis—The subjective symptoms are a sharp, sticking pain on respiration, diminished respiratory excursion of the lower part of the chest on the diseased side and occasionally cyanosis. There may be pain or tenderness of the liver region and neighboring parts of the abdomen up to the ileo-cecal region. This may be mistaken for gallstones or appendicitis. The same things may be found on the left side. The longissimus dorsi muscle may be tender.

Exudative Diaphragmatic Pleuritis—The exudate

may be overlooked if the layers of pleura become adherent as the fluid then gathers between the lungs and diaphragm. This results in a descent of the diaphragm, liver and spleen.

D. Pleural and Mediastinal Adhesions and Thickening of These Structures Within the Thoracic Cavity

Marked pleuritic adhesions may produce the following: the chest on the diseased side may appear smaller, especially in the antero-posterior diameter, the intercostal spaces drawn in, narrow and resistant, and the supra- and infra-clavicular fossæ may be sunken in. The muscles of the neck on the diseased side may be atrophic and the respiratory excursion of the entire diseased side or only a portion of it may be diminished. The chest wall may be entirely or partially drawn in. The diaphragm may be high or quiet (the upper portion of the abdomen on the diseased side quiet). The mediastinum and heart may be displaced towards the diseased side.

Dullness of the region over the adhesions may be of variable intensity to complete dullness and the respiratory and passive movement may be absent. There may be a louder percussion tone in the para-vertebral region on the diseased side as compared with the tone over the region of the adhesions.

Auscultation—Diminished breath sounds. All variations from rough breathing to veritable bronchial breathing, with all sorts of rales may be found in

coincident interstitial pneumonia and bronchiectasis, especially over the places where the thickening is not so marked (relative nearness of the lungs). The vocal fremitus is usually diminished over the thickening but it may be increased if the lung is infiltrated behind the thick pleura. Bronchophony and whisper bronchophony may also be increased.

Signs of compression of the mediastinal structures, similar to those in mediastinal tumors, may occur in extensive and markedly shrinking thickenings. There may be stasis in the veins and lymphatics, collateral circulation on the chest wall, signs of stasis of the vena cava, congested veins of the neck or of the arms, cyanosis, swelling of the neck from chronic stasis of the lymphatics and *Stokes' collar*. There may also be signs of compression of the arteries and bronchial or esophageal stenosis. There may be signs of irritation or paresis of the vagus (*recurrens*, pulse frequency) and of the sympathetic (difference in the pupils). *Oliver-Cardarelli* sign positive (*Radonicic*). This sign is elicited by grasping the thyreoid cartilage and slightly raising it. The larynx is tugged downwards during systole of the heart. It is best done with over-extension of the head in the sitting or lying positions. It should not be mistaken for transmitted pulsation of the carotids.

E. Pneumothorax

The entire lung may be retracted from the chest wall by the ingress of air in the pleural cavity (com-

plete pneumothorax). The process may be partial if there are adhesions (sacculated pneumothorax). The air in the pleural cavity may communicate externally (open pneumothorax) by an opening in the chest wall or by a tear of the lung tissue (superficial cavity, etc.). There is then, often, inflammatory irritation of the pleura with exudate (see sero-pneumothorax). The air in the pleural cavity may also be shut off from the outside by closure of the opening in the thorax or lungs (closed pneumothorax). The opening in the lung may be closed like a valve during expiration while the air is allowed to enter during inspiration (valve pneumothorax).

The respiratory excursion in pneumothorax is diminished or absent but the chest itself is enlarged and the intercostal spaces bulge. The mediastinum and its organs are usually displaced. The diaphragm is low and the liver and spleen descend, depending on the degree of increased pressure within the pleural sac.

The percussion tone is usually hypersonorous over the air pocket and often with a tympanitic ring if the air is not under too great pressure (as in valve pneumothorax). The tympany disappears in the latter case with occurrence of moderate dullness. The tympany is not very distinct if the air content is small but is to be found chiefly where the air collection is greatest as in the upper parts of the axilla. There is a more resonant tone in the para-vertebral space on the normal side than normally (*Luger*).

The breath sounds are diminished and sometimes absent; especially in the lower portions. The breath sounds, when heard, show all varieties from roughened breathing to bronchial or amphoric type. Vocal fremitus and diminished bronchophony speak for closed pneumothorax. Whisper bronchophony sounds amphoric and is most distinct in open pneumothorax.

There is vicarious volumen pulmonum of the other side in extensive pneumothorax.

The symptoms of pneumothorax in the sacculated variety are found only in circumscribed portions of the chest. All the manifestations of pleuritic adhesions may appear alongside of the former.

Air and exudate in the pleural sac. The upper level of the fluid is horizontal and this is the case all around the thorax if there are no adhesions. The exudate may shift slightly. Succussion on shaking of the patient. The upper limit of the exudate takes on a new horizontal level on change of position. The dullness may become resonant when the patient is on his back and the same happens to the posterior dullness if the patient is on his abdomen. "Gutta-cadens" and water sound.

F. Volumen Pulmonum Acutum

Enlargement of the pulmonary volume occurs acutely during an asthmatic attack or as a clinical expression of pulmonary emphysema.

The thorax is wide, epigastric angle obtuse, costal arch raised, intercostal spaces narrow and bulging,

the upper thoracic aperture raised and the respiratory excursion diminished. Tension of the thoracic compressors (outer margin of the latissimus dorsi). Rigid, dilated thorax in emphysema with frequent pillow-like bulging of the medial portion of the supra-clavicular fossa. Labored and prolonged expiration. Descent and diminished respiratory excursion of the lung margins. The cardiac part which normally lies against the thorax is often partially or completely covered by the distended lung. Hyperresonant percussion tone over the lung, especially over the lower parts. Auscultation reveals the characteristic prolonged expiration and the frequently complicating bronchitis causes raw breathing with dry and moist rales, especially the former. There may be any variety of rales in this condition.

In absence of function in a large part of the lungs there are all the signs of a localized *volumen pulmonum* in the functioning parts (vicarious emphysema).

G. Volumen Pulmonum Diminutum

There may be a retraction of the margins of the lungs in chlorosis as a result of superficial breathing. The retraction may disappear after repeated deep breaths. Similar findings in *Basedow's* disease. (See retraction of the lung margins in shrinking diseases of the lungs, page 47.)

HEART AND VESSELS

Heart

INSPECTION OF THE CARDIAC REGION

Bulging or retraction of the thorax (see types of thorax), visible pulsations, visible apex beat, position, extent and intensity of the pulsation of the apex beat. Systolic indrawing at the apex in *accretio* and *concretio cordis et pericardii*. Differentiation from rotatory indrawing (systolic sinking-in of the right and upper portion of the heart), especially with enlarged heart. There is also diastolic throwing forward in *concretio cordis* (*Brauer*).

Visible pulsation over the rest of the heart, especially over the large vessels, base of the heart, left margin of the sternum, at the lower part of the sternum (epigastric pulsation, right ventricle, and abdominal aorta). (See page 116.)

PALPATION OF THE CARDIAC REGION

Orientation palpation of the apex with the flat of the hand and then more detailed localization of the apex with the finger tips. Palpation of the entire precordial region, at the base and lower sternum. This is best done with the volar surface of the wrist.

Apex beat often not palpable when lying down,

hence examine with slight bending forward and also when on the left side. Variable displacement of the apex to the left in the left lateral position.

Quality of the apex beat—Heaving in contradistinction to the normal beat. The slow heave with the powerful movement occurs in hypertrophy of the heart (renal affection, arterial hypertension, aortic stenosis). There is also a rapid forward heave as in aortic insufficiency and in hyperkinesis (especially in a *Basedow's* heart or nervous tachycardia).

Palpable closure of the aortic and pulmonary valves at the base of the heart and occasionally double beat of the valves (see doubling of tones, page 107).

Palpable thrill during the various phases, presystolic at the apex in mitral stenosis. At other phases as presystolic-diastolic, systolic, rather continuous (see congenital disease, page 115), also presystolic, premature beat. Short thrills may be palpated as a vibration.

Intensity and localization of the thrill as in the aortic region, extending from the right, second intercostal space, diagonally across the sternum to the attachment of the third rib to the sternum (*Erb's* point). Systolic or post-systolic thrill in aortic stenosis and less frequently diastolic in aortic insufficiency. A thrill in the left second intercostal space in lesions of the pulmonary valves. Systolic thrills, often prolonged into diastole in patent *ductus Botalli*. Thrill over the middle of the sternum in defect of the septum.

Abnormally strong heaving of the lower sternum in hypertrophy of the right ventricle and also epigastric pulsation. This is to be differentiated from visible and palpable pulsation of the abdominal aorta (especially in splanchnoptosis) and from liver pulse. Direct palpation of the hypertrophic right ventricle during resting of the diaphragm or by deep palpation under the rib margin at the height of inspiration.

PERCUSSION OF THE CARDIAC REGION

Method and procedure of the examination—The anterior lung-liver margin to the right should be first determined on percussion (see page 46), then the position of the right border of the heart on moderately strong percussion (the finger must be firmly held against the parts). (The tone becomes higher as soon as it is dull.) It is more difficult to determine the cardiac dullness in the cardio-hepatic angle (at the lower portion of the right border of cardiac dullness in the region of relative dullness of the liver). Distinct dullness is the sign to be used in this determination. The left border of the heart is determined with somewhat lighter percussion but also with the finger firmly against the chest. The left, upper border is determined by moderately strong percussion. By assuming that the left lower border of the heart (apex) begins where the tone is nearly absolutely dull, it is possible to make the percussed dullness correspond the closest with the orthodiagram. The upper left and right borders of the heart (frontal projection) should

be determined when the tone is distinctly dull as the structures in the hilus, especially in stasis of the lesser circulation, may interfere (*Felsenreich*). Non-consideration of these points may lead to the determination of the cardiac dullness over too large an area.

Determination of the size of the heart is then taken up by percussion of the various intercostal spaces. The outline is thus ascertained as well as the medial area of dullness (large vessels).

The normal configuration shows a concave outline in the region of the left auricle. The cardiac boundaries should be determined on standing and lying down; the former is often best.

The so-called absolute dullness is identical with the position of the anterior margins of the lungs (see page 46).

AUSCULTATION OF THE CARDIAC REGION

Auscultation is performed in the lying, standing, left and right side positions, knee-elbow position and with the head bent slightly forward. The stethoscope is usually used except in soft diastolic aortic murmurs. The stethoscope may be tipped to one side or the ear slightly elevated from the stethoscope if there are murmurs which hide the heart tones or if other difficulties interfere with the latter.

Auscultation at the usual places; the mitral valve at the apex, pulmonary valves at the 2nd and 3rd intercostal spaces near the sternum, aortic valves in the 2nd right intercostal space near the sternum and in

the aortic region (see page 86), and the tricuspid valve over the lower sternum. The second tone at the apex is composed chiefly of the 2nd aortic and shows the characteristics of that tone while the 2nd tone at the lower sternum corresponds more to the pulmonary valve. The first tone corresponds to the beginning of systole of the ventricle and follows the long pause between the beats. The tone which comes with the apex beat or carotid pulse (not the radial pulse) may be considered as the first heart tone in rapid or irregular heart action. Shortening of the pulse (pendulum rhythm, embryocardia). Then auscultation of the entire precordial area, especially the lines connecting the previously mentioned points of auscultation.

Description of the several tones according to loudness (accentuation), height, ringing or dull, sharp ending, not sharp ending and the maximum area over which the tone is heard. It is normally possible to differentiate between the 2nd aortic and pulmonic tones. The former is higher, shorter and more distinctly limited as to time, while the pulmonary tone is deeper, duller, longer and does not end sharply (*Heitler*). These differences are also distinct in accentuation of the 2nd aortic and pulmonic tones.

The acoustic characteristics of the tones may be modified by changes in the conducting media to the chest wall (diminution in pericardial effusion, precordial effusions or thickenings, exudative pleuritis or thickening, tumors, etc.). The tones are increased, especially in infiltration of the overlying parts of the

lung. The heart tones may be ringing or metallic in accumulation of air near the heart as in pneumopericardium, pneumothorax, cavity in the lung, large air bubble in the stomach, etc. Hypertrophy of the ventricle causes dull tones and a loud first tone occurs in poor filling of the ventricle (mitral or tricuspid stenosis, anemia with oligemia). The first tone is normally louder at the apex and tricuspid areas while the second tones are louder at the base of the heart.

For splitting and doubling of the tones (see page 107).

Murmurs. Soft murmurs are best heard upon holding the breath during expiration.

A. *Endocardial murmurs*—These are limited to definite phases of the heart action, become somewhat fainter during inspiration and during the test of *Valsalva*; are not modified by pressure from without and have a definite localization and extent.

MORE DETAILED DESCRIPTION OF ENDOCARDIAL MURMURS

1. *Determination of location in general.*
2. *Determination of place where most distinct.*
3. *Determination of the phase of heart action.*

Systolic murmurs are synchronous with ventricular systole; diastolic with ventricular diastole and other murmurs such as presystolic, postsystolic (also called mesosystolic, occurs during systole but is separated from the first tone by a very short period) and post-

diastolic murmurs (in diastole and separated from the second tone).

4. *Changes in intensity* of the murmur during its course; increase or decrease of the murmur at its end.

5. *Character*—Raw, soft, blowing, flowing, rubbing, rolling, ringing, musical, etc.

6. *Loudness*—Loud, soft, distant.

7. *Conduction*—To the large vessels, axillary space, interscapular space, towards the spine at the lower cervical or upper thoracic vertebræ, liver region, etc. (see page 109).

B. *Pericardial Murmurs*—They are not definitely associated with certain phases of the heart action, usually shuffling in character or like scratching, often soft, appear near to the ear, may represent the "locomotive rhythm", are unchanged during inspiration and are louder upon the *Valsalva* test or pressure with the stethoscope. They are often distinctly limited to a circumscribed region of the precordium so that they may be heard only after the rest of the precordium has been auscultated. They are changed to variable degrees by change in position (bending forward or knee elbow position), and are independent of breathing in contradistinction to pleuro-pericardial murmurs (see page 60).

C. *Cardio-pulmonary Murmurs*—These are soft, systolic, at the region of the anterior margin of the lungs, pulse rhythm, depend on the respirations and disappear on maximal inspiration. They occur in the borders of the lungs by suction of air during the sys-

tolic contraction of the heart. (See cog-wheel breathing, page 57.)

Vessels

ARTERIES

Inspection and palpation—Determination of the filling condition, changes in the wall and the various qualities of pulse (see page 6). *Palpable thrills*.

Auscultation—Spontaneous tones and murmurs are to be differentiated from pressure tones and murmurs. The latter are the result of pressure of the stethoscope on the vessel while the former are heard without any pressure or even at some distance. Tones are heard over the large and middle sized arteries when there is moderate compression centrally from the site of auscultation (best heard by application of the elastic arm band of a blood pressure apparatus or pressure with the finger, taking care not to completely obliterate the pulsation). A pressure tone occurs at the site of compression of the large and middle sized vessels on very strong pressure.

Carotid and Subclavian Arteries—Two tones are usually heard. One is softer and corresponds with heart systole and tension of the vessel while the second tone is usually louder and is the conducted aortic tone. The same tones are heard in the jugulum and three tones may sometimes be heard in this place (*Ortner*).

Murmurs may be transmissions of the aortic tones either in systole or diastole. A pressure tone on very light compression of the carotid speaks for a change

in the wall of this vessel (*Litten*). Murmurs are sometimes heard over the subclavian artery, especially in processes in the lung apex. They are systolic or prolonged and usually increased or heard only during expiration (kinking of the arteries by adhesions with the pleura).

Brachial Artery—Normally no tones. Aortic insufficiency may cause single and sometimes double, spontaneous tones. These findings are sometimes also observed in thyreotoxicosis, *Basedow's* disease, pulsus celer and relaxation of the vascular wall in infectious or toxic processes.

Abdominal Aorta—A spontaneous tone is often normally heard and especially in aortic insufficiency, cardiac hyperkinesis, thyreotoxicosis, *Basedow's* disease, fever, etc. Pressure murmur on slight compression speaks for change in the wall. Double murmur in aortic insufficiency. *Aneurysm*: compression murmurs from compressing abdominal tumors.

Femoral Artery—A soft tone is occasionally heard normally. Single or double tone in aortic insufficiency (*Traube*). Increasing pressure with the stethoscope produces at first a single murmur and the characteristic double pressure murmur (*Duroziez*). Still greater pressure produces a single compression murmur and still greater pressure produces a pressure tone.

Double tones, and more rarely, double murmurs are also heard in excited cardiac action, fever and *Basedow's* disease. A split crural tone may be heard in dicrotic pulse.

Small arteries of the hand and foot. Soft tones in aortic insufficiency (volar-tone), but these may be absent if there is sclerosis of the vessels.

VEINS

In addition to the veins of the trunk and extremities, the veins of the neck are also to be observed. All of these may show visible pulsation. Abnormal filling of the cervical veins may be due to a general venous congestion or local stasis in the region of the superior vena cava.

The genuine *venous pulse* must be differentiated from the one transmitted to the veins by the carotid. The venous pulse has a more flat, undulating movement which may sometimes be seen to have two summits (auricular and ventricular stasis ridge, the former presystolic and the latter mesosystolic). The cervical veins become more distinctly filled with certain positions of the head or trunk, especially with head lowered or turned to one side, but occasionally in the vertical position of the head and trunk.

Condition of the large veins during respiration. Normal disengorgement during inspiration. Paradoxic condition, congestion on deep inspiration in pathological changes in the region of the mediastinum (mediastinal tumor, mediastinitis fibrosa, mediastino-pericarditis and substernal struma).

PULSATIONS

1. Negative Venous Pulse

A. *Physiological collapse* of the veins at the beginning of ventricular systole.

B. *Present pathologically* in stasis of the right auricle without complete collapse of the veins. Stasis in the pulmonary circulation in paralysis of the right ventricle and tricuspid stenosis. The first crest in the venous pulse is especially prominent in tricuspid stenosis.

2. *Positive, ventricular systole*, venous pulse, recognizable when the auricular crest disappears in auricular fibrillation. It is synchronous with systole of the ventricle and is especially distinct in insufficiency of the venous valves. It may be recognized on auscultation or palpation of the heart. It is either a congestion pulse by compression of the cervical veins (no refilling below the site of compression) or a genuine retrograde pulse wave (refilling proximal to the site of compression with previous smoothing out of the vein).

It occurs in organic and functional insufficiency of the tricuspid, auricular fibrillation and tachycardia and extra-systole with normal nodal rhythm. Also in combinations of mitral insufficiency with open foramen ovale and after perforation of an aneurysm into a vein.

A positive liver pulse usually accompanies a positive venous pulse at the neck. The transverse expansile

character in the change in volume due to the pulse may be demonstrated by bimanual palpation (systolic, diastolic or presystolic). To be differentiated from transmitted pulsation of the abdominal aorta, right ventricle, pulsating tumors of this region but with difficulty from arterial liver pulse (see aortic insufficiency).

The liver should be grasped between the two hands to demonstrate a liver pulse, as from the flank towards the middle or from anteriorly to the posterior aspect. The separation of the hands during pulsation is the important feature.

High grade aortic insufficiency may also produce visible, positive, venous pulse in the small peripheral veins of the extremities and liver (penetrating venous pulse, liver pulse). This may be due to a continuation of the celer pulse of the arteries into the veins.

Auscultation of the cervical veins.

A continuous, systolic murmur, increased during inspiration may be heard in anemia and especially in chlorosis. A bulbus-tone may occur in some cases of tricuspid insufficiency and in venous valves which can still close (*Bamberger*).

CAPILLARIES

Capillary Pulse—Determined by causing a slight anemia of the nail bed or on a site of the skin which is made hyperemic by rubbing, especially on the skin of the forehead. Rhythmic redness and pallor in pulsus celer.

DIAGNOSTIC VALUE OF THE VARIOUS PHYSICAL FINDINGS AT THE HEART AND VESSELS

1. Inspection and Palpation

PULSATING BULGING IN THE REGION OF THE HEART

A. *Apex beat.*

1. *Position:* normally palpable in the 4th or 5th interspace but may not be palpable under normal conditions, marked filling of the lungs or it may be hidden by overlying pericardial thickening, pleural effusion or effusion of the pericardium, tumors, abnormal thickenings of the chest wall, etc.

Determination of the Position of the Apex Beat— Measurement of the distance in centimetres from the midline or estimation of the distance to the left medioclavicular line. There may be a difference of one or two fingerbreadths when the patient is on the left or right side. Suspect *accretio cordis* if this shifting does not occur. Shifting upwards in high position of the diaphragm (horizontal position of the heart) and towards the median line and downwards in descent of the diaphragm (vertical position of the diaphragm). The apex beat is more median in small hearts. *Oliver-Cardarelli sign* often present in perpendicularly suspended heart. (See page 77.)

Displacement of the apex beat to the left or to the left and downwards is found in :

(a) Shifting of the heart to the left in processes diminishing the space in the right thorax or right mediastinum (considerable effusion on the right side, high grade ascent of the diaphragm as in subphrenic abscess, large tumors of the liver, diaphragmatic evagination, etc.).

(b) *Pulling of the heart* by shrinking, connective tissue processes in the left half of the thorax (pleural and pleuro-pericardial thickenings, shrinking tumors).

(c) *Enlargement of the left ventricle.*

(d) *Enlargement of the right ventricle* with resulting displacement of the left ventricle.

2. *Quality of the apex beat*—Normally hardly palpable, may be covered by the tips of one or two fingers, rapid in hyperkinesis (neurasthenia, thyreotoxic hearts, etc.) sometimes with coincident, slight vibration. The apex beat may be striking, short and hard as in mitral stenosis as a result of the rapid contraction of the poorly filled ventricle as well as in hemorrhage and anemia. There is a loud first tone in these conditions.

Heaving in hypertrophy of the left ventricle ("locomotive-like"). No displacement in simple hypertrophy if the heart muscle is in good condition (arterial hypertension, renal disease, aortic stenosis). The heaving is slow. Displacement in eccentric hypertrophy (rapid) in the before mentioned conditions with dilatation. Also in practically all valvular diseases. It

is absent in pure mitral stenosis. It is found in affections of the aorta as mesaortitis luetica, aneurysm and atheroma.

Wide apex beat so that it takes several finger tips to cover it and may be felt in several intercostal spaces. Found in thin thorax, hypertrophied heart closely applied to the chest wall and in partial aneurysm of the heart at the apex.

The overlying ribs may be elevated during pulsation of a heaving and widened apex beat.

Doubling of the apex beat, caused by premature, presystolic beat and in which the first tone is shorter and weaker (mitral stenosis). Double beat in asynchrony of the ventricle.

B. Pulsating elevation of the lower sternum

In hypertrophy of the right ventricle with dilatation; as a sign of compensation in tricuspid or mitral lesions, double aortic and mitral lesions, disease of the pulmonic valves, septum defect, patent ductus *Botalli*, pulmonary emphysema and extensive thickening in the region of the lungs or pleura. Also in kypho-scoliosis, long-standing pneumothorax (increased pressure and increased resistance in the lesser circulation) and in hypertrophy of the entire heart.

Lifting of the sternum and epigastric pulsation occurs in thyreotoxic hyperkinesis (*Basedow*, Basedowoid, goitre heart) with and without hypertrophy of the right ventricle.

A normal but excited heart may cause a vibrating

heaving of the lower sternum in a delicate elastic thorax, especially in the young.

C. Epigastric Pulsation

C. Epigastric Pulsation—In descent of the diaphragm, with and without hypertrophy of the right ventricle, in splanchnoptosis and in emaciation.

Differentiation of epigastric pulsation caused by the heart from that caused by pulsation of the abdominal aorta, liver pulse, pulsating tumors or tumors to which the pulsation is transmitted. (See page 92. See page 24 for technic of palpation.)

D. Pulsation to the left of the sternum at the level of the second interspace may be of the pulmonary artery or normally in rare instances in delicate chest wall. May be conducted by interposition of infiltrated parts of lung or by fixation of the pulmonary artery by connective tissue to the wall. Also in abnormal condition of the wall of the pulmonary artery or denudation of this vessel by shrinkage of the left lobe of the lung or retraction of the margins of the lung by decreased volume (chlorosis, *Basedow*), and in dilatation of the pulmonalis (mitral stenosis, patent ductus *Botalli*, pulmonic insufficiency, congenital pulmonic stenosis, septum defect, aneurysm of the pulmonary artery, etc.).

E. Pulsation of the aorta with conduction to the right of the sternum. Dilatation or aneurysm of the aorta and aortic insufficiency with overstretching of the aortic wall.

F. *Pulsation in the region of the left auricle* in hypertrophy and dilatation of the same as in mitral stenosis.

G. *Pulsation at various places* as in double pulsation in aneurysm (*Stokes*).

Pulsating Indrawings

Obliterating pericarditis with fixation to the posterior mediastinum may cause this phenomenon at the apex or in the region of the apex. The apex may be thrown forward in this condition (*Brouer*), or there may be a coincident systolic indrawing to the left, posteriorly and below (*Broadbent*). To be differentiated from systolic indrawing at the same place in descent of the diaphragm. This indrawing in pericardial obliteration is to be differentiated from rotatory indrawing. The indrawing of the latter is above and to the right of the apex but the apex beat may not be demonstrable or may be normal, resistant or heaving.

Pulsation of the Jugular Fossa

Visible and palpable in abnormal length of the aorta (high aortic arch in high diaphragm, elongation of the aorta or pulling or pushing of the arch), or result of pulsation of an aneurysm. The most common cause is a dilated arteria anonyma or one which is pushed upward.

Palpable Thrills in the Heart Region

1. *At the apex.* Systolic in mitral insufficiency or conducted as in aortic or pulmonic stenosis, patent ductus *Botalli*, septum defect. Short vibration in simple hyperkinesis. Present over a wide area and also in the axilla in the former condition. More localized to the apex in aortic stenosis. Presystolic and at times outside of the area of cardiac dullness in mitral stenosis and may be localized to a small area.

Diastolic thrill in mitral stenosis or conducted from congenital malformations.

2. *An isolated thrill* in the tricuspid region is rare (valvular lesion of the right heart). It is more frequent as a conducted thrill.

3. *At the aortic or pulmonic regions*—Systolic in stenosis of the arterial ostia and diastolic in insufficiency of the semilunar valves. The thrill may be conducted to the large vessels and jugular fossa in aortic stenosis. Systolic thrill may be present in severe changes of the wall without stenosis (meso-ortitis, atheroma, verrucous deposits). Systolic thrill of the pulmonary artery in patent ductus *Botalli* and reaching into diastole. It is also conducted from the sternal region in septum defect.

Aneurysm may produce thrills in any phase of cardiac action, depending on the position in relation to the chest wall. (See pulsation and bulging, pages 18 and 97.)

II. Percussion

The right border of cardiac dullness reaches in a slight convex bow to the right border of the sternum or slightly beyond it. The distance from the midline varies according to the height of the diaphragm and the configuration of the thorax. It is useful to measure the right and left borders of cardiac dullness in centimetres, as from the median line. The left lower border of the heart is convex externally and does not normally extend beyond the left medioclavicular line. The distance from the median line to the right border of cardiac dullness averages about 4 cm., and to the left about 8 cm., but this is subject to variations depending on the position of the diaphragm, vertical heart, etc.

DISPLACEMENT OF THE HEART

In *situs viscerum inversus totalis* or *partialis* in which the apex beat is to the right and below. A similar finding is present in pulling or pushing of the mediastinum. The apex in this case is left and low in relation to the dullness. The cardiac dullness may be displaced upwards or downwards by the level of the diaphragm. (See page 46.)

Abnormal mobility of the heart may result in considerable shifting on assuming the left or right position. The dullness found on standing may disappear on lying down in such a heart, due to interposition of the lung margins when the heart drops backwards.

*Diminution in Size of the Cardiac Dullness,
Especially at its Widest Diameter*

Occurs in vertical heart and is characterized by low diaphragm and abnormally small heart (also in normal position of the diaphragm). (See displacement of the apex inwardly, page 93.)

Widening of the Cardiac Dullness to the Right

1. *Pushing or pulling of the entire heart* to the right (control with left border or apex). Displacement of the right heart by greatly enlarged left heart (aortic insufficiency, renal disease).

2. *Enlargement of the right heart*—Enlargement of the right auricle alone or normal sized auricle pushed to the right by a large right ventricle. Hypertrophy of the right ventricle with heaving or elevation of the lower sternum and step-like configuration of the left anterior margin of the overlying right lung (covering the right heart).

The upper portion of the right border of the heart may occasionally be formed of an abnormally dilated left auricle which extends to the right (mitral stenosis). The lower portion of the right heart border may occasionally be formed of markedly enlarged right ventricle.

The differential diagnosis may be very difficult between cardiac dullness enlarged to the right from mediastinal exudate, tumor, thickening, areas of infiltration of the lung and infarct.

*Extension of the Cardiac Dullness to the Left
and Downwards*

In displacement of the entire or left heart by the right side, enlargement of the left ventricle and pericardial effusion (the apex beat may be within the area of cardiac dullness when stooping forward). Differentiation from extra-cardial dullness (see right border of the heart). Left sided pleural exudate at the base may be differentiated from cardiac dullness by the intensity of the dullness. (See condition of *Traube's space*, page 73.)

*3. Enlargement of the Left Upper Part of the
Area of Cardiac Dullness*

This may be caused by an enlarged left auricle or pulmonary artery. Differentiation is not possible on percussion alone but may be possible by palpation of the nature and phase of the pulsation. The enlarged left auricle is especially prominent in mitral lesions as mitral stenosis, etc. Enlarged pulmonary artery should be considered in pulmonary insufficiency and patent ductus *Botalli*. A stripe-like area of dullness may be present in the latter condition to the left of the sternum in the second interspace.

A filling out of the concavity of the outline of cardiac dullness occurs in the several conditions mentioned and leads to the so-called "mitral configuration." Prominence of the lower left part of the cardiac dull-

ness forms the "aortic configuration" (shape of a swimming duck).

There is not uncommonly moderate dullness at the back, to the left of and near the spine in enlargement of the left auricle, especially in mitral stenosis. This may be present either high or low, that is, from the 2nd to the 4th thoracic or from the 5th to the 7th thoracic vertebra (*Ortner*). There is occasional slight dullness in the region of the entire left upper lobe and left apex (diminished air content of these parts).

4. *Enlargement of the Area of Cardiac Dullness
in All Dimensions*

5. *Enlargement of all the parts of the heart* in combined valvular disease and severe myocardial disease. The cardiac dullness in relaxed heart is like a triangle with the base on the diaphragm.

Pericardial effusions may cause enlarged cardiac dullness. This dullness shows a pronounced increase towards both sides and the left lower margin often is outside of the apex beat while the right border forms a right angle or acute angle with the relative dullness of the liver (corresponding to the diaphragmatic cupula) (*Luger*). The demonstration of these conditions is seldom possible.

The percussion tone over the entire area of cardiac dullness to the extreme margins is intensely dull. The area of absolute dullness nearly conforms to the contour of the heart. This is due to the pushing apart of the lung margins. The lung-liver margin forms an

obtuse angle with the lower portion of the right border of the absolute dullness (*Rotch, Epstein*). This angle does not correspond anatomically to the cardio-hepatic angle but is called by this name in spite of that. The liver dullness becomes more intense in the vicinity of the exudate.

An increase of the absolute dullness in all directions, especially of the dependent parts, occurs if the patient changes from the lying position to the sitting posture. The upper parts of the dullness are increased in area on bending forward, especially with the knee-elbow position.

A zone of dullness in the region of the lungs, posteriorly, to the left and below, may be found in large retro-cardial effusions (*Bamberger*).

There may be a hypersonorous or tympanitic tone over the heart in pneumo-pericardium. Fluid with air in the pericardial cavity (pyo-, sero-, hydro-pneumo-pericardium), causes a zone of dullness in the lower part of the area of tympany, the upper border being horizontal, if the patient sits up.

ENLARGEMENT OF THE AREA OF MEDIAN DULLNESS

Large Vessels

Diffuse dilatation of the ascending aorta, usually luetic, causes an area of dullness to the right of the sternal margin in the 2nd and 3rd interspace with the convexity to the right. Enlargement of the median dullness to the right may also be caused by mediastinal

tumors with displacement of the vena cava superior or tumors with displacement of the aorta to the right.

Dullness of the upper part of the sternum. The slight dullness which is normally found over the upper part of the sternum may be increased entirely or in parts (aneurysm or dilatation of the aortic arch in the median line, substernal struma). (The latter may show an elevation of the thoracic dullness on swallowing, increase of the intensity of the dullness during deep inspiration which is in contrast to aortic dullness in which the dullness is diminished by the increased air content of the lungs during inspiration). Extreme enlargement of the left auricle may occasionally cause dullness of the upper part of the sternum.

*Enlargement of the Area of Median Dullness
to the Left*

Enlargement of the physiological dullness from the aorta at the junction of the left, second rib and sternum in widening of the sagittal aspect of the aorta (*Kreuzfuchs*). This place normally shows a rounded, vaguely outlined zone of dullness of a maximum diameter of 2 cm (*Jagic-Kreuzfuchs*). (See above, left auricle.)

Aortic aneurysm may cause enlargement at any side of the median dullness regardless of from what portion of the aorta the aneurysm arises.

III. Auscultation

(a) Cardiac Tones

First tone at the apex. Abnormally dull in damaged heart muscle, especially if there is also hypertrophy or by reason of overlying pulmonary emphysema, pericarditis, thickenings, etc. Abnormally snappy in mitral stenosis, severe anemia from hemorrhage, and extra-systole, either corresponding to the extra-systolic contraction or to the heart tone following the pause. The reason in the first is the small volume of the beat, and in the second the recuperation of the heart muscle after the pause. The first tone is also abnormally loud in hyperkinesis of the heart.

The first tone may take on a ringing character in interposition of thickened lung. Metallic resonance may be due to an abnormally large air bubble in the upper part of the stomach, neighboring cavity, pneumothorax, pneumo-pericardium, emphysema of the skin, diaphragmatic hernia, etc.

The first tone at the lower part of the sternum in comparison with the first tone at the apex may be somewhat prolonged and dull in hypertrophy of the right heart.

The Second Heart Tone—The second tone at the apex is chiefly aortic in origin and that over the lower sternum is chiefly from the pulmonic area. The pulmonic tone should be localized and may be dull, deep, prolonged or vaguely distinct. Its optimum is in the

region of the right ventricle or in the pulmonic region in the 2nd or 3rd left intercostal spaces. The difference in the character of the tone will help to distinguish the pulmonic 2nd from the aortic.

A. *Second Pulmonic Tone*—Accentuation of the second pulmonic may mean increase of pressure in the lesser circulation (mitral disease, patent ductus *Botalli*, pulmonary emphysema, thickenings, scoliosis, etc.), together with hypertrophy of the right ventricle. The accentuation of the 2nd tone disappears if the right ventricle is weak or in tricuspid insufficiency. Both tones in the pulmonic region are abnormally loud in denudation of the pulmonalis following retraction of the pulmonary margins as in chlorosis or shrinking processes of the left upper lobe.

The second tone is also accentuated in supraclavicular pulmonic stenosis but is softer in valvular pulmonic stenosis. An accentuated pulmonic second is often an expression of a physiological narrowing of the pulmonary artery in young, growing individuals.

A ringing second pulmonic tone is sometimes found as a result of the rarely occurring pulmonary sclerosis with changes in the wall. This sign on auscultation may be hidden by the ringing aortic second which is transmitted. The cause of a ringing pulmonic second may be due to some special factors in conduction as infiltrated lung tissue, cavity formation in the lungs, pneumothorax, emphysema of the skin, etc.

B. *Second Aortic Tone*—Accentuated in higher pressure in the great circulation, arterial hypertension.

An abnormally loud second tone may occur in pendulous heart and if the large vessels are close to the chest wall. The tone may again become normal on Glenard's test of pushing upwards on the abdomen. The second tone may be soft when the heart tones are weak as in pericarditis, thickenings, etc. The 2nd aortic may also be softer in aortic stenosis of valvular nature while it is accentuated in supravalvular stenosis and may be normal in subvalvular stenosis. It may also be soft in peripheral hypotonia, severe acute hemorrhage (the first tone becomes loud) and in cardiac weakness. A poor prognosis may be expected if the 2nd tone which has been loud becomes soft during infectious disease as an expression of high grade toxic hypotonia, especially of the splanchnic vessels (*Ortner*).

The 2nd aortic becomes ringing in changes in the wall of the aorta as in sclerosis, mesaortitis or aneurysm (*Schroetter*). For abnormal resonance see paragraph on pulmonic second tone.

SPLITTING OR DOUBLING OF THE HEART TONES

Splitting or doubling of the first tone.

1. *Post systolic accessory beat (Geigel)*—The accessory tone is short, soft as compared with the main tone. It may be ringing and raw in aortic sclerosis. No gallop rhythm. Often heard normally at various localized places. Found in increased pressure and aortic sclerosis.

2. *Presystolic Accessory Tone (Auricular Tone)*—The tone is duller and softer than the main tone and occurs in disturbance in conduction, mitral stenosis, hyperkinesis of the heart, hypertrophy of the ventricle and ventricular dilatation.

Note the interval of time between the accessory and main tones.

3. *Both tones may show the same acoustic qualities* as a result of unequal contraction of the ventricles in regard to time. There may be gallop rhythm (arterial hypertension, especially in shrunken kidney and mitral disease).

Splitting or Doubling of the Second Tone

Caused by closure of the valves at the arterial ostia at different times.

1. *Inspiratory Doubling*—Pulmonic tone too early, gallop rhythm not present. This doubling may be seen normally in excited heart action.

2. *Long Standing Doubling*—Either the pulmonic or aortic tones may be too early. No gallop rhythm (increased pressure in the lesser circulation, mitral disease, especially mitral stenosis. Increased pressure in the greater circulation as changes in pressure in the ventricles, chronic nephritis, arterio-sclerosis and valvular disease of the heart).

In addition to the previously mentioned presystolic accessory tone, there is also a dull accidental diastolic or presystolic tone in mitral stenosis. Gallop rhythm possible.

(b) MURMURS

*Systolic Murmurs*1. *At the apex.*

A. In incomplete closure of the mitral valve as a result of endocarditic changes (valvular mitral insufficiency).

Without anatomical changes at the margins of the valve in functional (relative or muscular) mitral insufficiency.

Mitral murmurs are usually more distinct upon lying down than on sitting or standing and are usually transmitted to the axilla and toward the back under the left shoulder blade. There are all varieties and are usually decrescendo in character. They may be raw, soft, blowing or musical. They may come immediately after or cover the first tone. They may be heard over the entire precordial region with the maximum intensity at the apex or in the 2nd or 3rd left interspace, as is often the case in fresh endocarditis and more rarely in special topographic conditions of the left auricle (*Naunyn's* mitral insufficiency).

B. As conducted murmurs from other ostia. Differentiated by determining the maximal point as well as by the varying character of the murmur. The murmur from aortic stenosis and from verrucous endocarditis of the aortic valves is usually rawer and louder. The same is true in pulmonic stenosis.

C. Accidental murmurs may be anemic and not due to muscular insufficiency or cardio-pulmonic murmurs,

or they may be the so-called fever murmurs or tachycardia murmurs. These usually show their maximum at the base of the heart in the region of the pulmonic, are often inconstant and depend on the position and movement of the body. Accidental murmurs may be suspected if there is no sign of enlargement of any part of the heart or sign of circulatory disturbance of any sort.

2. *Over the Tricuspid.* Systolic murmur at the lower sternum, usually conducted from the mitral or as a result of tricuspid insufficiency of valvular or functional nature. These murmurs are differentiated from mitral murmurs by the rough character. The maximal point is at the site of auscultation of the tricuspid and is increased by bending forward and pressing upward of the liver (*Heitler*). Often transmitted to the liver region or to the right and below.

3. *Systolic Murmur at the Base of the Heart*

(a) *Pulmonic region.* The majority of the functional murmurs are most distinct at this region. Systolic murmurs also occur in pulmonary sclerosis and pulmonic stenosis (conduction in the lungs, occasionally conduction along the large vessels in the neck). Also in the supra-valvular stenosis of the pulmonalis resulting from compression by glands, aneurysm, tumors, etc. These murmurs are usually somewhat late in systole. Systolic murmurs may be found in patent ductus *Botalli* or may be transmitted from other ostia.

(b) *Aortic region.* In aortic stenosis, roughness of the aortic valves or wall. The murmur is usually post-systolic. Systolic murmurs also occur in marked disproportion between the lumen of the aorta and left ventricle as an expression of relative aortic stenosis. It is almost constant in aortic insufficiency, even without stenosis, and in aortic aneurysm may also be transmitted from other ostia. These systolic murmurs are usually in contrast to mitral murmurs in the large vessels of the neck and in the jugulum, especially in aortic stenosis (conditions of the 2nd tone, peripheral vessels and pulse, see pages 6 and 106).

A systolic murmur at the apex and aortic area may have two distinct causes and the murmurs may be separated by the difference in the tone (mitral murmur usually softer, aortic usually harsher); difference in phase (aortic murmur somewhat delayed and sometimes distinctly post-systolic). The fact that the murmurs are softer between the suspected areas of origin as compared with the tones at the apex and aortic area does not speak definitely for a double etiology if none of the foregoing signs are present.

DIASTOLIC MURMURS

The most frequent and loudest are the diastolic murmurs at the aortic area (2nd right interspace near the sternum and diagonally to the attachment of the 3rd rib on the left side), but it may be heard anywhere over the heart as at the apex, the pulmonic area or left auricle.

1. Diastolic murmur as a sign or valvular aortic insufficiency. The murmur is blowing or flowing and decrescendo in character. It is often heard only on standing or at certain places, as at *Erb's* point to the left of the sternum. It is frequently very soft. The murmur diminishes in intensity in all directions, as towards the large vessels of the neck and apex where it may again have a second point of maximum intensity. It may be heard in some cases as an isolated murmur of changed character at the apex and should be differentiated from mitral stenosis. The 2nd tone is usually retained except in severely damaged valves which cannot vibrate any more.

There are rare instances in which diastolic murmurs at the aortic area are functional in nature as in functional insufficiency of the aortic valves as a result of extreme arterial tension (disappearance of the murmur in lowering of the pressure as after venesection and also in drawing away of the valves as a result of the aortic wall being drawn outwards by shrinking processes in the vicinity). It may also be due to degeneration and relaxation of the circumvalvular muscle fibres as in severe anemias (*Ortner*).

The diastolic aortic murmur is best differentiated from the murmur of mitral stenosis by its decrescendo character. A diastolic murmur in the aortic region may be due to a transmitted murmur from the pulmonic area. It is possible to mistake the soft diastolic aortic murmurs for breath sounds but this may be prevented by auscultating between respirations.

2. *In the Pulmonic Region*—Most commonly in insufficiency of the pulmonic valves with variable character of the 2nd pulmonic tone (accentuated, normal or soft).

The second pulmonic tone is abnormally loud or abnormally soft, pulsus celer absent at the peripheral arteries, high grade hypertrophy and dilatation of the right ventricle, murmur heard over the lungs, no transmission into the large vessels of the neck and especially not in the right carotid. Pulsus celer in the pulmonary artery. A double tone may be heard over the lungs analogous to the double tone of Traube (*Gerhardt*). Cog-wheel breathing over the lungs synchronous with the pulse.

The diastolic murmur in mitral stenosis may, in some cases, be heard only at or best at the base of the heart to the left of the sternum.

3. *At the Apex*—Transmission from the base with decrescendo character (see above). Rarely transmission to the aortic area in mitral stenosis, more frequently toward the lower sternum.

4. *In the tricuspid region* as a sign of tricuspid stenosis with presence of other signs of this lesion, especially a large right auricle, loud first tone over the right ventricle, limited transmission, limitation to the lower and right border of the sternum, distinct presystolic, venous pulse or presystolic liver pulse.

PRESYSTOLIC MURMURS

At the apex as a sign of mitral stenosis, typically rolling, crescendo character. The crescendo may be lost in auricular fibrillation and the murmur is separated from the first tone by a very short interval. This murmur may arise in insufficiency of the aortic valves as well as in mitral stenosis (*Flint's murmur*). A presystolic murmur may occasionally be present in narrowing of the mitral opening as a result of thrombus formation, surrounding calcifying ring (in pericardial obliteration), etc.

The following varieties may be found in mitral stenosis in addition to the typical findings on auscultation mentioned above.

1. *Continuous, diastolic murmurs*, crescendo character, reaching up to the first tone.
2. *Isolated diastolic murmurs*, especially in auricular fibrillation.
3. *Short, post-diastolic murmur*, separated from the tone which follows it by a long interval.
4. *Absence of any murmur*, the single sign of mitral stenosis being the accentuation of the first tone (dumb mitral stenosis).
5. *Doubling of the first tone* by the presystolic early beat.
6. *Occurrence of an independent second diastolic tone*.

POST-SYSTOLIC OR MESO-SYSTOLIC MURMURS

These are separated from the first tone by a short interval. Usually best heard at the aortic region in aortic stenosis and in roughness of the valves or aortic wall (arteriosclerosis, lues, endocarditic excrescences). It is not an absolute sign of aortic stenosis in which it occurs but such a condition may be suspected when there is a corresponding change in the pulse and absence or weakness of the 2nd tone.

It occurs in rare cases of mitral insufficiency, but the maximum point is at the apex.

Analogous condition in pulmonic stenosis with localization of the murmur to the left of the sternum.

CONTINUOUS MURMURS

In defect of the septum (hissing and increased during systole), also as the so-called "Mill" murmur in the presence of air and fluid in the pericardial sac or entrance of air in the ventricle (air embolus). The murmur has a peculiar splashing metallic ring.

APPENDIX

Auscultation of the Tones and Murmurs at the Back

These may be heard at the back in a thorax wall which is not too thick or if the tones or murmurs are sufficiently loud. Localization of the maximal point of the tone and murmurs on dorsal auscultation; 2nd pulmonic at the level of the 4th thoracic vertebra, to the right of the spine. Second aortic at the level of the 1st or 2nd thoracic vertebra to the left and right of the spine (the origin of an accentuated tone may be determined in this manner). Systolic murmur in aortic stenosis on both sides of the spine at the level of the first to the third thoracic vertebra. Murmurs in pulmonic stenosis (stenosis at the ostium or by compression of the pulmonary artery) in the midline at the level of the spine of the fourth thoracic vertebra. Mitral murmurs to the left of the spine at the level of the sixth to the eighth dorsal vertebra (dilatation of the left auricle (*Kürt*)).

The tones of the thoracic aorta (tone of the vascular tension as a result of the celer blood wave) may be heard as a cardiac systolic tone or soft post-systolic tone in the left para-vertebral space along the spine in insufficiency of the aortic valves. This may occur even if the first tone over the aorta is not heard. The

same may be true of the first tone at the apex if there is also mitral insufficiency.

ABDOMEN

Inspection and Palpation (see pages 23 and 24)

Percussion

Determination of the percussion tone first in the median line and then in the navel-horizontal line. Dullness in the flanks is determined by this method. Percussion of the liver, spleen, stomach and then of the entire abdomen.

PERCUSSION OF THE ABDOMINAL ORGANS

Percussion of the Liver

See page 46 for determination of the lung-liver margin. Determination of the "dome" of the liver usually possible only with strong percussion (relative dullness). The lower border with the lightest percussion and in some cases with moderately strong percussion if the colon lies over the liver. The border of the liver leaves the costal arch at the right medioclavicular line and goes upwards and to the left towards the left costal arch at the left para-sternal line.

Descent of the lower border of the liver is found in displacement or enlargement of the organ (controlled by determining the upper border of the liver). Determination of enlargement of the liver as a whole or

of certain parts. Ptosis of the entire liver in descent of the diaphragm, large pleuritic exudate, emphysema, ptosis and subphrenic abscess. Enlargement in passive congestion, biliary stasis, diffuse parenchymatous changes and tumors. Lues attacks the left lobe by preference.

There is an oval area of dullness attached to the lower border of the liver in enlargement of the gall-bladder or presence of a *Riedel's* lobe. Two such separated areas of dullness may be present over a normal liver if there is a segment of bowel covering the liver. The connection between two such areas of dullness may sometimes be established by grasping the lower portion of the tumor bimanually and pushing it caudally as far as possible during inspiration. The lung-liver dullness is then determined on percussion and it is found to ascend higher in expiration after the tumor is liberated.

The liver dullness becomes smaller in shrinking or atrophic processes, when the liver stands on edge, in meteorism, interposition of intestine between the liver and diaphragm, high grade tympany and presence of free gas in the abdominal cavity. In the latter instance the tympany may wander all over the abdomen on change of position and disappearance of the liver dullness as in perforation peritonitis. Another cause may be the accumulation of localized gas between the liver and diaphragm (gas containing subphrenic abscess).

Traube's space is a tympanitic zone which is

bounded on the left by the dullness of the anterior border of the spleen, to the right by the left border of the left lobe of the liver, below by the costal arch and above by the lower border of the lung or heart.

The space is enlarged in meteorism, especially of the stomach, in small liver and shrinking pleuritic processes on the left side.

Diminution from the right or left by enlargement of the spleen or liver or by tumors in this region. Diminution from above in descent of the left dia-phragm (large pleuritic exudate, hydro-pneumothorax, pericarditis, enlarged heart, normal but low heart and tumors in the vicinity). Diminution from below by encroachment by tumors in the vicinity, as carcinoma of the stomach.

The tone on percussion over *Traube's* space changes according to the filling condition of the stomach and may be different on standing or lying down.

Percussion of the Spleen

Best done with the patient on his right side and his left arm elevated and on his head. Determination of the upper and lower borders of splenic dullness in the mid-axillary line with very light percussion. Normally from the 9th to the 11th rib. The anterior border of splenic dullness is determined by percussing from the centre of the dullness, downwards and towards the costal margin. The anterior inferior border is usually 2 to 4 finger breadths from the costal arch. The posterior border cannot be determined

normally on account of the physiological dullness of the flank.

The thickness of the spleen may be estimated by the nature of the sound on percussion and various grades of intensity of percussion at the site of splenic dullness where it was most marked in the previous determination. Determination of the actual size of the spleen with moderately strong percussion (relative dullness). This dullness ordinarily reaches about two finger breadths higher into the lungs as compared with the dullness previously obtained.

Dullness of an enlarged spleen may be increased in all or only some directions, depending on whether it is a generalized or localized enlargement of the organ. Very large spleens cause a dullness which is continuous and not interrupted by intestinal tympany.

Percussion of the Kidney

The kidneys cannot normally be percussed from the anterior aspect. It is frequently possible to determine the lower and lateral borders of the kidneys and they may be differentiated from the lumbar musculature and adjacent intestinal segments which give a dull tympany to the regions outside of the kidneys. Percussion of the kidneys is performed along the line of prolongation from the scapular line near the spine. This percussion should also be attempted in the knee-elbow position, sitting, stooping over and on the abdomen. The trunk should be supported on pillows in such a manner so that the back will be somewhat

kyphotic. This percussion may be of importance in determining ectopic or enlarged kidneys.

Renal tumors are characterized by the fact that the overlying bowel (colon) tympany may hide the dullness on percussion. It may be necessary to inflate the colon. Another feature is the fact that the dullness posteriorly of the tumor is continuous with that from the kidney.

Abnormal Regions of Dullness in the Abdomen

(a) *Free fluid* (transudate or exudate). Dullness from fluid may be missed if the quantity is small and if the patient is on his back. The dullness may assume a circular outline in the most dependent regions, especially at the navel if the patient assumes the knee-elbow position.

Dullness in both flanks occurs in larger quantities of free fluid. The dullness may be limited horizontally at its upper border. The upper limits of horizontal dullness at the flanks may unite above the symphysis and form a continuous line with the concavity towards the head, if the fluid is present in large quantities. The entire abdomen may be dull under certain circumstances with the exception of a circular area of tympany in the middle or upper parts of the abdomen. This tympany is due to the floating intestines. Change of position from the supine to the side positions may produce change in the level of the fluid. The upper portion is tympanitic in free fluid. In the sitting and standing position the fluid gravitates to the pelvis and leaves the upper part of the flanks more

tympanitic. It may then be possible to determine a horizontal line of dullness above the symphysis. It may take some time before the above mentioned changes take place. The changes may be limited if there are adhesions.

Large quantities of fluid in chronic shrinking processes of the mesentery (tuberculosis, carcinoma) may produce a broad zone of tympany extending from the upper abdomen diagonally to the right and below, to the ileo-cecal region. This zone may be permanent (*Thomayer's sign*; fixation of the small intestines to the oblique line of attachment of the mesentery of the small intestine with shrinkage of the mesentery in the lower right abdomen). Dullness of this region and in the presence of large quantities of fluid may produce dullness in the right lower abdomen if light percussion is used and if there is a thin layer of fluid between the intestines and abdominal wall, but the characteristic area of tympany in the right lower region is found if stronger percussion is used (*Olhausen*).

Dullness may occur in the flanks normally if the large or small bowels are filled with feces, or are empty and contracted, as in obstipation, fecal tumors, inanition, meningitis and cholera. The dullness may clear up slightly in the upper regions in the flanks on assuming a lateral position and is then due to the gravitation of the colon downwards, but there is no increase of dullness at the opposite flank and the horizontal

dullness above the symphysis is absent on sitting or standing.

(b) *Other varieties of dullness in the flanks.* Bilateral dullness in the upper portions of the flanks in renal tumors symmetrically located (cystic kidney). Unilateral dullness in tumors of various sorts (inflammatory, neoplastic, gravitation abscess, gland tumor, mega-sigmoid, invagination tumor, etc.). There may be change in tone on change in position in pedicled tumors (ovarian tumors, myomata, etc.), and in freely movable tumors as mesenteric cysts or tumors of the liver, kidney or spleen.

2. Dullness in the Remaining Portions of the Abdomen

In the upper abdomen (see above for dullness of the spleen and liver). Tumors of the stomach, abnormal filling of the stomach, especially in dilatation and tumors of the omentum, pancreas, small and large intestine.

In the lower abdomen: filled urinary bladder (proof by catheter), neoplasm of the intestine, female genitalia and tumors caused by mechanical disturbances as in invagination, etc.

Auscultation of the Abdomen

Rubs—All varieties from soft murmurs to harsh rubbing depending on the nature of the surfaces and occur especially in inflammatory changes of the peritoneum analogous to pleural rubs. Most frequent in

the regions of the liver and spleen dullness (peri-hepatitis, peri-cholecystitis and peri-splenitis).

There may be cardiac rhythm of the rub in peri-hepatitis or the left lobe of the liver (pseudo-pericardial rub).

In raw surfaces due to other conditions as carcinoma.

Grinding murmur over the gall bladder in rare instances in the presence of stones.

Vascular Murmurs—There are one or two tones over the abdominal aorta (see page 89). Pressure murmur with the cardiac systole on pressure over the vessel. This may be produced by tumors overlying the abdominal aorta. Systolic murmur or prolonged systolic murmur in aneurysm of the aorta or splenic arteries.

Continuous buzzing murmurs at times increased during systole over dilated veins (buzzing cirrhosis).

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